VOLUME 41
NUMBER 8

AUGUST, 1954

plating

NEW AES LEADER INSTALLED

See Page 921

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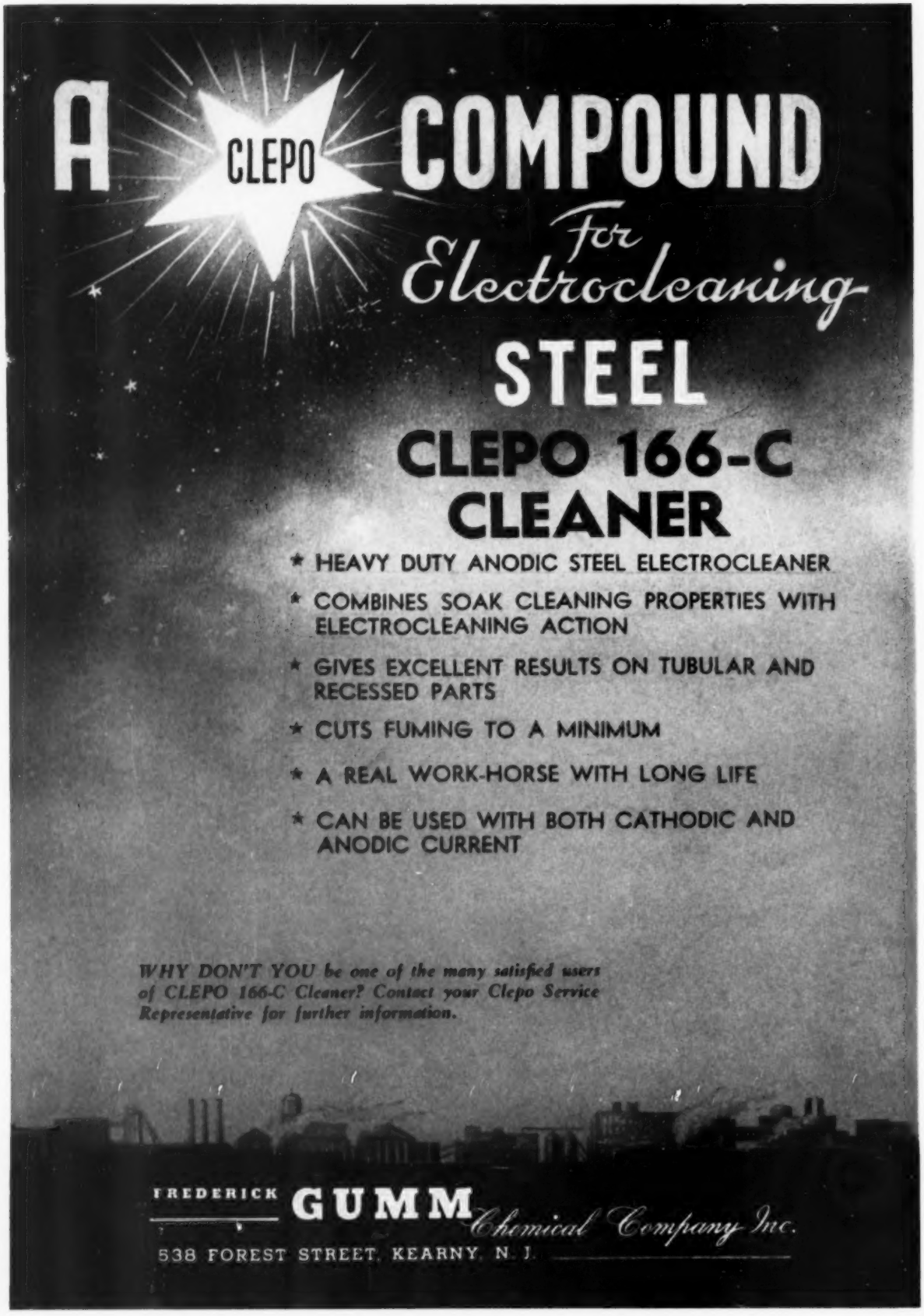
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For Electrocleaning
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★ COMBINES SOAK CLEANING PROPERTIES WITH ELECTROCLEANING ACTION
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WHY DON'T YOU be one of the many satisfied users of CLEPO 166-C Cleaner? Contact your Clepo Service Representative for further information.
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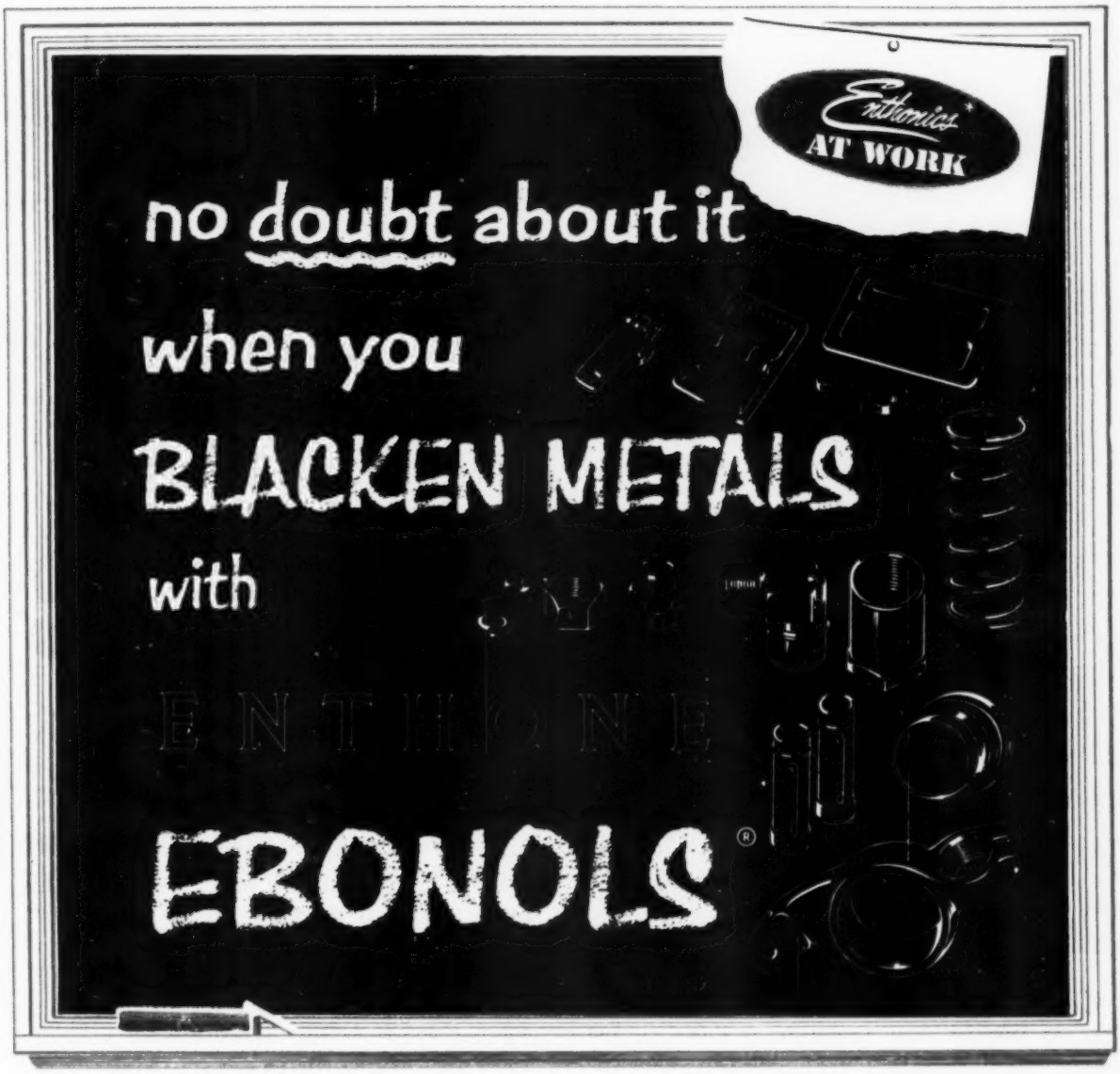

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For **COPPER and BRASS**

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ELECTROPLATING CHEMICALS

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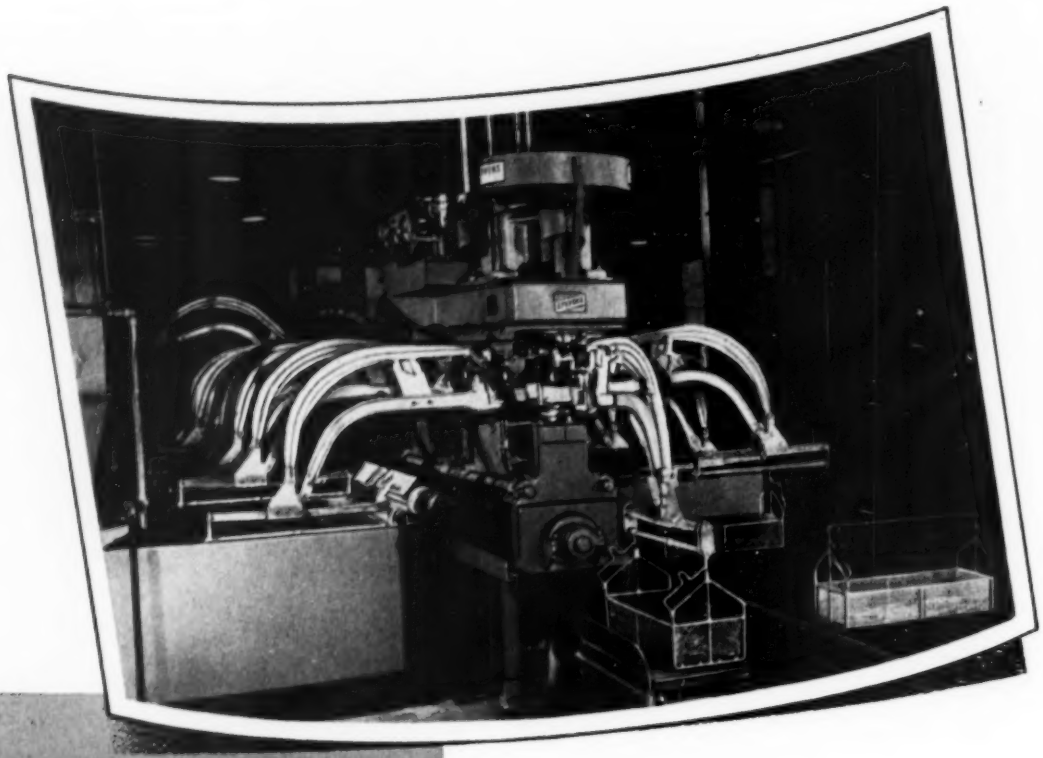

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STEVENS AUTOMATIC PROCESSING MACHINE CHANGES REQUIRED CYCLES FOR THESE TWO METALS IN SECONDS . . . .

Harvey Metal Corporation, Chicago, Illinois, are now Bright Dipping many thousands of aluminum and brass forged parts each day. A Stevens Automatic does the job. Result: Production is up . . . appearance is up . . . costs are down.

Mr. James R. Anderson, Jr., president of Harvey Metal Corporation, writes: "It is safe to say that with the Stevens machine we have cut in half the cost of acid and caustic dipping of brass and aluminum forgings."

Customers' reports of on-the-job results from many other companies using Stevens machines echo Mr. Anderson's comments. A list of these customers is a veritable "Blue Book" of American industry.

The versatility of the Stevens equipment is amazing. Delayed set-down and skip bracket features provide for timing and selectivity in the treatment of different metals in one machine. When automatic loader and unloader attachments are added, only one man is required for the operation. Here is truly automatic finishing at its finest.

If you are interested in cutting costs and increasing production in your metal finishing operations, call your Stevens Sales Engineer for a thorough analysis of your processing needs. Or write direct to Frederic B. Stevens, Inc., Detroit 16, Michigan.

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YOUR METAL FINISHING SUPERMARKET
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plating

August, 1954 — Dedicated to the improvement and dissemination of the knowledge of the arts and sciences of electroplating and of finishing of metals and of allied arts. — Vol. 41, No. 8

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This month's cover shows newly elected AES president, Dr. R. A. Schaefer, receiving gavel and copy of "Roberts Rules" from outgoing president, Dr. G. P. Swift, as past president, F. J. MacStoker, looks on.

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Editorial

Looking Ahead to 1955

Speaking on behalf of the AES, our many friends and guests who attended the successful New York convention, I say sincerely what is in the hearts of all—"Thanks a million" to the hard-working New York Branch for a truly wonderful convention.

Every successful meeting does not "just happen." It takes years of planning and skillful administration by the Host branch. Already, as the echoes of the 41st convention fade over Manhattan, next year's program is being mapped out.

Our twins of 1955, the 42nd Annual Convention and the 4th Industrial Finishing Exposition will be held in Cleveland and again will offer simultaneously an integrated educational program and an industrial exhibit covering the metal finishing field.

We all recognize the fact that our industrial growth toward higher-quality products at lower unit costs and the extension of our technology into new fields are the results of a well coordinated research, development, and mass production processes. Without the stimuli of research motivated by individual and company financial reward in a free and competitive economy, our industrial progress will become stagnant.

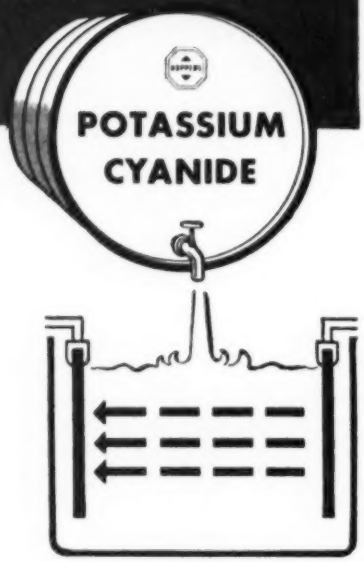
The many contributions from our members in advancing the science of electroplating and metal finishing at educational sessions of conventions and in PLATING assure our industry a rosy future. The combination of technical papers and their discussion, in addition to exhibits of production equipment and supplies, offers us and potential members a great opportunity for technical advancement.

Our Society is proud to offer this exposition at irregular intervals in conjunction with a convention for maximum benefit to both exhibitor and member alike. Thus, with an eye toward 1955, we sincerely hope that you, too, will start making plans for another successful convention and exposition. . . this time in Cleveland.

Ralph A. Schaefer

AES President

How to save money by speeding-up your electroplating operation



If your normal plating operation includes the dangerous and troublesome step of dissolving cyanide granules for the plating bath, plus the time-consuming task of cleaning out so-called "empty" drums of poisonous cyanide powder dust, this proposition is directed to you.

Koppers Potassium Cyanide Solution (35-40%) completely eliminates the dissolving step in your plating procedure. It is available in 55-gallon drums which may be cleaned by a simple water wash. No preparation is necessary. Or it can be delivered to you by tank truck, pumped directly from the truck into your storage tank, ready to use.

Koppers Potassium Cyanide Solution will save you time and labor costs, in addition to minimizing the danger of working with cyanides. Moreover, compared to cyanide granules, Koppers Cyanide solution is moderately priced.

Potassium Cyanide is one of the many synthetic chemicals produced by Koppers. Others include Resorcinol, Styrene Monomer, Polystyrene, Phthalic Anhydride, Divinylbenzene, and Di-tert-butyl-para-cresol.

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In This Issue

A Study of Leveling in Cyanide Copper Baths by Barnet D. Ostrow and Fred I. Nobel is the first paper presented at the 1954 AES Convention. In this article the authors discuss the leveling accomplished by plating in cyanide copper solutions of various compositions. The text begins on page 885.

A Study of Leveling in Acid Copper Baths is a companion paper to the previous one and is written by the same authors. A number of factors are studied with respect to their effect upon leveling. Gardam's "surface truth," rather than the mere reduction of the RMS value after plating, is claimed to be a better measure of surface smoothness. A theory is developed to explain the greater leveling obtained in acid copper solutions as compared to cyanide copper solutions. The text for this begins on page 892 and the convention discussion for both papers will be found at the end of this article.

Industrial Applications for Metallized Nonconductors, by author Harold Narcus, describes recent developments in the plating of materials such as glass, ceramics and plastics. Particular emphasis is placed upon the use of this technique in printed circuitry, mask manufacture, medicine and dentistry. Bath compositions, sensitizing formulas and procedures are given in the story beginning on page 901.

Modern Industrial Paint Strippers by Rubin Operowsky was the fourth paper presented at the forty-first AES Convention. This article describes the requirements for paint strippers in terms of paint composition and presents information on the applications for the various types of strippers available. Full text starts on page 915.

Convention Echoes and photographs taken at the New York Convention will be found on pages 884 and 922 to 924, respectively.

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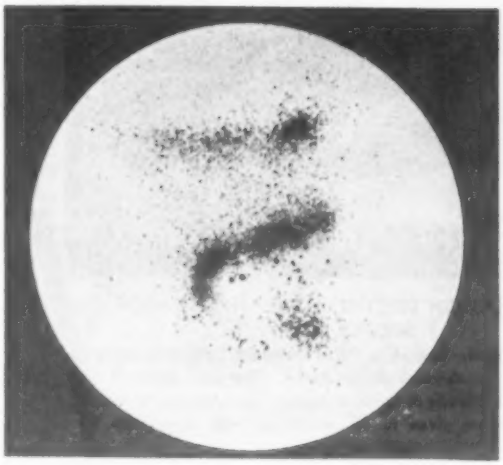

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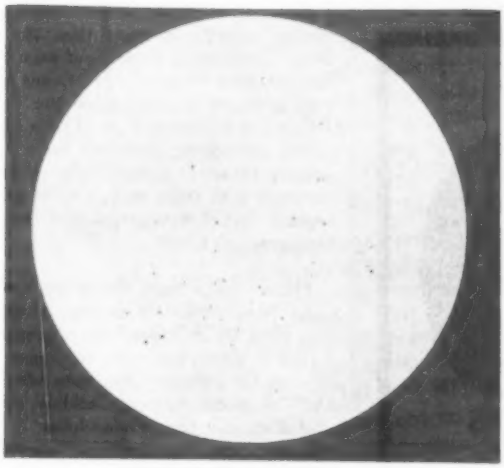

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4. **Greatly decreases dragout losses; helps solve rinsing and waste disposal problems.**
5. **Proved by case histories to be the lowest cost by far for any low-foam surface active agent. Used regularly in thousands of gallons of chrome baths for over six years.**

The above unretouched photographs of the Paper Test of Mist from Chrome Baths was first published in October, 1947. It illustrates the remarkable effectiveness of NO-CRO-MIST in reducing chrome spray before the present, even more effective NO-CRO-MIST was developed.

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Please send copy of the Summary On Chromium Intoxication and complete information on **NO-CRO-MIST®**

Name..... Title.....
Company.....
Street Address.....
City..... Zone..... State.....

Industry News

MW Surface Cleaning Service. The MW Protective Coatings Division of Metalweld, Inc., Philadelphia 29, Pa., has completed the installation of one large sandblast chamber in their new Scotts Lane Plant. In addition to having three large blast cleaning rooms, they have special sandblast equipment which consists of tumbling barrels, cabinets and portable units for field work. This service organization specializes in sand and grit blasting to remove rust, mill scale, old paint and heavy corrosion from all types of metal surfaces such as weldments, pipe, press stampings and large tanks. Many industries throughout the Delaware Valley use MW's surface cleaning service on structural steel, bridges, ships, barges, etc.

CHANDEYSSON ELECTRIC COMPANY AWARDS SERVICE PINS

James F. Carland, Executive Vice-President, presents service awards at the Chandeysson dinner dance. Pins were given to 80 employees with 5 years or more of service. In addition, engraved gold watches were given to 15 employees with more than 25 years of service

FORMAX

the Perfect Combination

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ZIPPO CLOTH BUFFS

These famous long-wearing buffs run cool under all buffing conditions. High count bias-cut cloth is assembled on ventilated steel centers. Each section is perfectly balanced and faced—requires no raking.

BUFFING COMPOUNDS

Formax produces a complete line of buffing compounds in bar, tube and liquid form.

Our extensive manufacturing, laboratory and testing facilities are at your disposal.

ZIPPO SISAL BUFFS

You have a pleasant surprise coming if you haven't tried the new Zippo bias-type sisal buff. It was specifically developed for steel buffing—to blend polishing grit lines—to cut down stainless steel—and bring up a bright lustre.

Other Formax products include the well-known C-20 Flexible Contact Wheels and F-26 Abrasive Belt Grease Stick.

Descriptive Catalogs Sent on Request

FORMAX MFG. CORP.

DETROIT 7, MICHIGAN

"THE FOUR McALEERS"

Nickel Plating Capacity Expanded. The Evans Products Co., Plymouth, Mich., has purchased a fully automatic Udylite nickel plating unit to increase its plating capacity by more than 200 per cent. The plating department expansion was necessary because of the Evans company's recent acquisition of the Cycle Division of the Colson Corp., Elyria, Ohio.

The new plating plant unit has a 9,000 ampere capacity, hydraulically operated conveyor with rising rack, a 1,350 gallon capacity nickel plating tank and 410 gallon chromium tank.

Philadelphia Sales Office for American Nickeloid. American Nickeloid Co., Peru, Ill., manufacturers of preplated metals in sheets and coils, announces the opening of a Philadelphia sales office in the Western Saving Fund Building, Broad and Chestnut Sts., Philadelphia 7, Pa. The new office was established, according to Carl C. Struever, general manager of the company, in the interest of better service to the firm's customers in that area. Simultaneously, the firm revealed that it closed its Detroit sales office.

Marc F. Hermann, the company's former representative in Detroit, is in charge of the new office. Hermann has been with American Nickeloid Company since 1938 and has worked out of both the New York and Detroit offices.

POSITION AVAILABLE

Supervisor for polishing and plating department. Able to maintain solutions. Production wise. Salary and commission. Opportunities.
Reply to:

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CHANDEYSSON ELECTRIC COMPANY
4078 Bingham Avenue — St. Louis, Missouri

GOLDEN JUBILEE 1904 Chandeysson 1954

MEMO

TO YOU...Our Customers

WHAT'S HAPPENING AT CHANDEYSSON?

What has made Chandeysson the talk of the industry? Here are the answers as we see them—simply this . . .

In a progressive, virile program, launched a couple of years ago, these important decisions were made:

- To build an organization for expansion.
- To acquire more and better facilities, tools.
- To strengthen marketing policy and methods.
- To establish even higher standards of quality and service.
- To tell the advantages of generators for power conversion—particularly Chandeysson.
- To continue with products of integrity . . . a heritage that has earned respect and attention for fifty years.

TODAY...

. . . your enthusiastic response, proved by statistics and intangibles, justify these decisions. Chandeysson production is at an all-time high . . . more customers are buying Chandeysson products than ever before. Production meets your delivery requirements . . . you get more machine value per dollar than ever before. Our engineering development program assures better service now and in the future. A capable sales organization is at your service.

. . . and all at a reasonable profit in the spirit of American Free Enterprise. This milestone of successful operation is based on a half-century of fair dealing, quality products, progressive engineering and management.

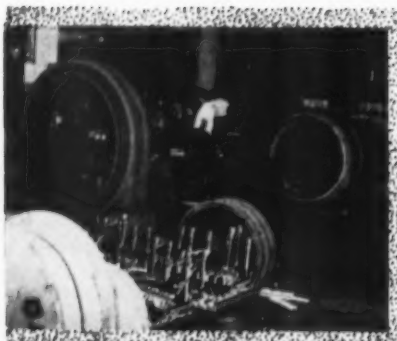
TOMORROW...

. . . you can discover for yourself

why Chandeysson is the standard of the industry . . .
why Chandeysson Generators are first choice of those who plan for years ahead . . .
why Chandeysson customers give us enthusiastic public endorsement . . .
how claims made can be backed up by the convincing proof of performance—now and for years to come.

James F Garland

Executive Vice-President
General Manager



BUILDING ... FOR

Chandeysson

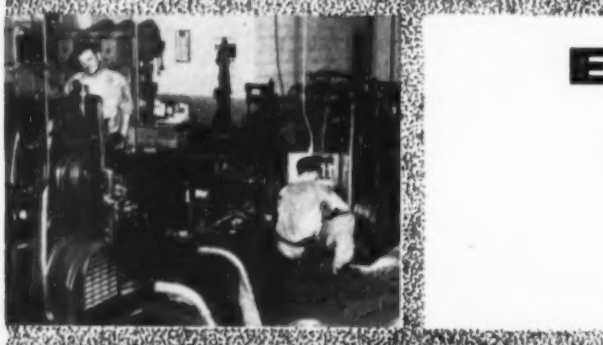
ELECTROLYTIC

Lifetime power conversio

Perfection of detail made the first Chandeysson generators so successful that today, long years after, many are still in daily service.

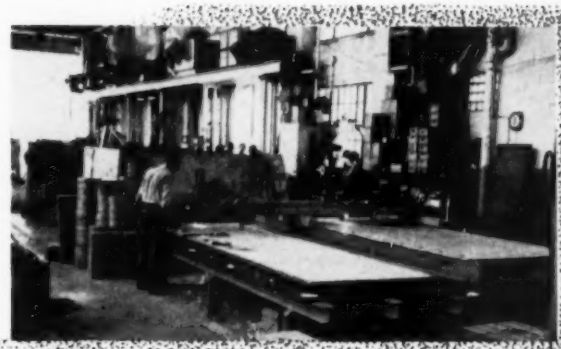
We take pride in doing little things well—in precision machining an extra thousandth in a tolerance—being sure insulation is carefully and uniformly applied—fitting bearings with exactly the right clearance. Workers at Chandeysson have a creed of craftsmanship that carries through from selection of

CHANDEYSSO



IN THIS MODERN, FAST-GROWING PLANT ***GENERATIONS OF***

THE *NEXT* FIFTY YEARS!



GENERATORS

. . at low cost

raw materials to shipment of finished products. Every task is important—and every man.

Shown on this page are some of the men and some of the operations responsible for the high quality of Chandeysson products. We invite you to visit us and see for yourself the care and skill with which Chandeysson is building to meet your needs, not only for today but for generations to come.

LECTRIC COMPANY

4078 Bingham Avenue • St. Louis, Missouri

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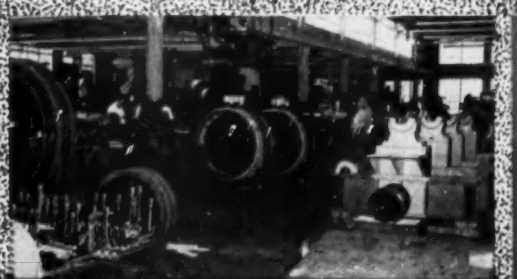
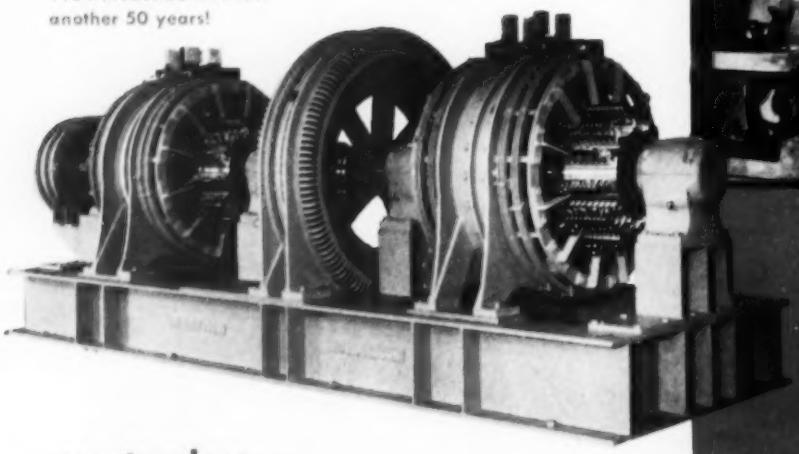


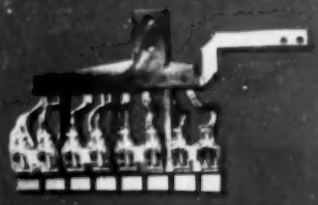
Factory views:
Chandeysson Electric Company,
Saint Louis, Missouri

GOOD SERVICE ARE BUILT INTO EVERY *Chandeysson* GENERATOR

1954 Model Built to last another 50 years!

1904 Model Still in daily service!





yesterday...

today...

tomorrow...

Chandeysson

first name in fine

ELECTROLYTIC GENERATORS

Every Chandeysson is built "from the ground up"—not assembled. Parts are specially designed, fabricated and integrated into each unit.

From this construction come three outstanding advantages to users:

1. **Built-in high power factor.**
2. **Sustained, lifetime overall efficiency as high as 85% that does not decrease with age or overload.**
3. **Overload capacity as great as 50% momentarily and 25% for long periods without distress.**

Yesterday, today, tomorrow . . . they're all the same to your Chandeysson generator. It keeps running . . . giving you lifetime dividends of highest quality performance, at lowest cost.

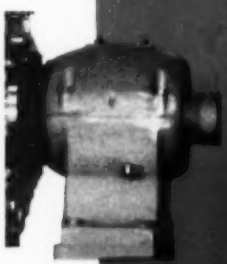
Bulletin D-102 contains data and specifications on Chandeysson machines. If you are interested in power savings and power dependability, it will pay you to read this bulletin. Your copy sent promptly, and without obligation.

Brush holder supports are of one piece bronze—precision machined, jig drilled and tapped for interchangeability and accurate positioning. Brush drag is balanced to eliminate skewing or vibration of brushes on the commutator.

Brush holders are accurately machined to assure snug fit that keeps them in place. Brush holders and spring assembly carry no current. Spring toggle arrangement assures uniform brush pressure throughout the life of the brush; yet permits open position to be held for brush inspection or replacement.

Collector ring assembly is same size as frame—with maximum access to brushes and commutator, for minor repair, inspection and maintenance in the coil and bus area. Open construction promotes cooling and reduces friction.

Sturdy, welded, stress relieved steel frames provide higher efficiency, greater strength and more flexible design.



Large size bearings (2½ to 1) assure long trouble-free life. Ample shaft diameter assures no flexing to overload any localized portion of the bearing—and maintains a sufficient air gap for stable operation.

CHANDEYSSON ELECTRIC COMPANY

4078 Bingham Avenue • St. Louis, Missou

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Industry News

Southwest and New York Distributors for Enthone. Enthone, Inc., New Haven, Conn., announces the appointment of Weaver Engineering and Supply Co., Inc., Grand Prairie, Texas (Dallas) as stock point distributor for their complete line of chemicals for the metal finishing industry. Stocks of Enthone products will be maintained at the Grand Prairie location for shipment to concerns in Texas, Oklahoma, Arkansas and Louisiana.

James Weaver, President, will continue to offer Enthonics service in this expanded area with the assistance, when necessary, of the Enthone technical service laboratory and Enthone engineers.

Announced at the same time was the appointment of Austin F. Fletcher, Inc., Binghamton, N. Y., as exclusive distributor for Enthone products and processes in the upper New York State and northeastern Pennsylvania area. Enthone chemicals will be stocked in the Austin F. Fletcher, Inc., warehouse and shipment to customers in the area will be made FOB Binghamton. Enthonics service in the area will be continued by Fletcher and Gordon Hall, resident representative in Rochester, supplemented by the chemists and engineers of Enthone's home office.

Parker Expands. A major expansion, the third within a four-year period, is underway at the Parker Rust Proof Co. in Maywood, Calif.

Increased storage facilities for raw materials and finished products, a 20 per cent increase in manufacturing capacity, and added operating efficiency and safety for employees will result when the project is completed.

Bonderite, Parco Compound and Parco Lubrite are produced at this Parker plant.

New D-Men. Three new D-Men, field representatives of The Diversey Corp., Chicago, recently have completed an intensive technical and sales training course and have been assigned territories to sell prefinishing cleaners and etchers to the metal working field.

Left to right (standing): T. M. Jordan (Eastern Division) and R. R. Hawthorne (Central Division); seated: A. Lanning, Jr. (Cleveland Division) and instructor W. G. Polzin

Second Big Expansion by F. J. Stokes. Rapid growth of the markets for its equipment—including high-vacuum equipment for processing organic chemicals, vaccines, antibiotics, and other "wonder drugs"; vacuum furnaces for refining uranium, titanium, and high-temperature alloys; vacuum metalizing equipment for television picture tubes, selenium rectifiers, and plating automobile trim and hardware; automatic loading equipment for ammunition; and extruders for plastic pipe—has led to the second large-scale plant expansion within 4 years for F. J. Stokes Machine Co., Philadelphia, Pa.

A $1 million expansion program that will enlarge its production facilities by another 40 per cent has been launched. The new program follows closely an expansion of about the same scale which was completed early in 1951.

Ground was broken on July 4 for a 50,000 square feet addition to the present

SITUATION WANTED

PLATING CHEMIST. B.S. degree in chemistry. Two years experience in plating laboratory. Worked with copper, nickel, chrome, gold, silver, cadmium, rhodium, and zinc, production solutions. Can handle all analysis and trouble shoot in plant. *Reply to:*

P-854-B, PLATING
445 Broad St., Newark 2, N. J.

BRASS PLATING WITH TRUE BRITE

❶ improve color

❷ save labor

❸ eliminate supervision

❶ *color stays constant . . . no rejects*

❷ *eliminates frequent analyses . . .*

❸ *trouble free . . . only one addition instead of three*

Write for FREE bulletin! Your key to better Brass Plating

Available in regular 3 to 1 ratio for yellow Brass Plating.

Special ratio materials for plating richlow brass or any other desired alloy of copper and zinc.

Suitable for both still tanks and barrels.

TRUE BRITE CHEMICAL PRODUCTS CO.
P. O. Box 31, Oakville, Conn.

FREE!

Calculator Solves Everyday Metal Cleaner Problems

INDICATES:

Tank Capacity in Gallons
Pounds of Cleaner per Charge
Pounds of Daily Make-Up Charge
Most Efficient Cleaner

● Pennsalt has developed a simple slide chart to do the usual everyday calculations for you. Reads in useful terms of gallons and pounds. Even suggests the most effective cleaner for a particular metal and cleaning process.

The Pennsalt Metal Cleaning Guide covers soak, spray, electrolytic and barrel-type processes. Takes only seconds to use, yet saves up to a half-hour of your time every day.

Get your free Metal Cleaning Guide by calling your local Pennsalt Metal Cleaning Specialist. Or write, on your letterhead, to: Metal Processing Dept., Pennsylvania Salt Mfg. Co., *EAST:* 826 Widener Bldg., Philadelphia 7, Pa. *WEST:* 2168 Shattuck Ave., Berkeley 4, Calif.

Pennsalt Chemicals

ATTENTION JOB PLATERS AND FINISHERS!

Here's a New Local Service Designed For Your Needs!

Pennsalt now provides *direct local* distribution in many areas in addition to their large staff of sales-service engineers and technical service men. The exclusive Pennsalt distributors listed below offer you qualified sales-service on Pennsalt Cleaners *plus* prompt delivery of materials from *local warehouse stocks, in these areas:*

NEW ENGLAND—POUGHKEEPSIE—ALBANY
Chemical Corporation
54 Waltham Avenue
Springfield 9, Mass.

BUFFALO—ERIE
W. M. Fotheringham Co.
975-981 Niagara Street
Buffalo 13, New York

CLEVELAND—AKRON—YOUNGSTOWN
General Supply Co.
5317 St. Clair Avenue
Cleveland 3, Ohio

CINCINNATI, OHIO
Herbert Chemical Company
Vine Street & Murray Road
St. Bernard

BALTIMORE, MARYLAND
Hughes Chemical Co.
1411 Fleet Street

MUSKEGON—GRAND RAPIDS
M C Supply
2410 Lake Avenue
N. Muskegon, Mich.

READING—PHILADELPHIA—DELAWARE
Textile Chemical Co.
Second & Spruce Sts.
Reading, Pennsylvania

CHICAGO, ILLINOIS
Joseph Turner Company
435 N. Michigan Ave.

INDIANAPOLIS—RICHMOND—NEW ALBANY
Ulrich Chemical Co.
31 E. Georgia Street
Indianapolis, Indiana

WISCONSIN—ROCKFORD—TWIN CITY
J. H. Schneider Co.
4858 N. Berkeley Blvd.
Whitefish Bay, Wisconsin

Contact your local distributor directly or write: Metal Processing Department, Pennsylvania Salt Manufacturing Co., 826 Widener Building, Philadelphia, Pa.

NEWS OF PENNSALT PRODUCTS

Industry News

Stokes' plant at 5500 Tabor Rd., in northeast Philadelphia, which will provide additional manufacturing space and larger office and engineering department accommodations. The new building is due to be completed by the end of the year.

California Firm Produces 100,000th Scientific Instrument. A scientific instrument made news recently as the 100,000th instrument produced by Beckman Instruments, Inc., South Pasadena, Calif., in its 20 years of operation.

The 100,000th scientific instrument produced by Beckman Instruments, Inc., is presented by Dr. Arnold O. Beckman (right) to Dr. R. Francis Faull, Manager of the California Research Corporation's La Habra Laboratory, during recent ceremonies at La Habra

The instrument—a new type recording spectrophotometer—will be used in research on petroleum hydrocarbons in the La Habra laboratories of California Research Corp., Standard Oil Co. of California subsidiary.

Dr. Arnold O. Beckman, president of the company, presented a gold nameplate commemorating the event to Dr. R. Francis Faull, Manager of California Research Corporation's La Habra Laboratory, in a recent ceremony.

H-VW-M and J. C. Miller Join Forces. Hanson-Van Winkle-Munning and J. C. Miller Company have announced their consolidation by the transfer of the physical assets, good will and organization of the J. C. Miller Company to Hanson. Plans call for operations to continue under the same general management and policy as previously with G. H. Walgren, president of Miller, remaining in charge of operations of the Miller organization. Arrangements have been made to include Walgren and J. C. Miller, chairman of the board of the Miller Company, on the board of directors of H-VW-M.

WANTED

Midwest Manufacturer of Buffing Compounds, Buffs and Polishing Wheels desires representation on West Coast on Commission Basis. We are an old established, well known manufacturer of quality products. *Reply to:* P-854-C, PLATING, 445 Broad St., Newark 2, N. J.

Wagner Brothers Appoints Distributors. Reynolds-Robson Supply Company of Philadelphia and Moehlenpah Engineering, Inc. of St. Louis, Mo., have been named distributors for Wagner products.

Reynolds-Robson will cover Eastern Pennsylvania, Southern New Jersey, Delaware, Maryland, Virginia, District of Columbia, North and South Carolina, Eastern Georgia and Florida. Moehlenpah's sales engineers will operate in Southern Illinois, Missouri, Iowa, Eastern Kansas and Eastern Nebraska.

Androus Ferric Chloride Production Expanded. To meet the growing demands of industry, the Pennsylvania Salt Manufacturing Company has more than doubled its capacity for the production of anhydrous ferric chloride.

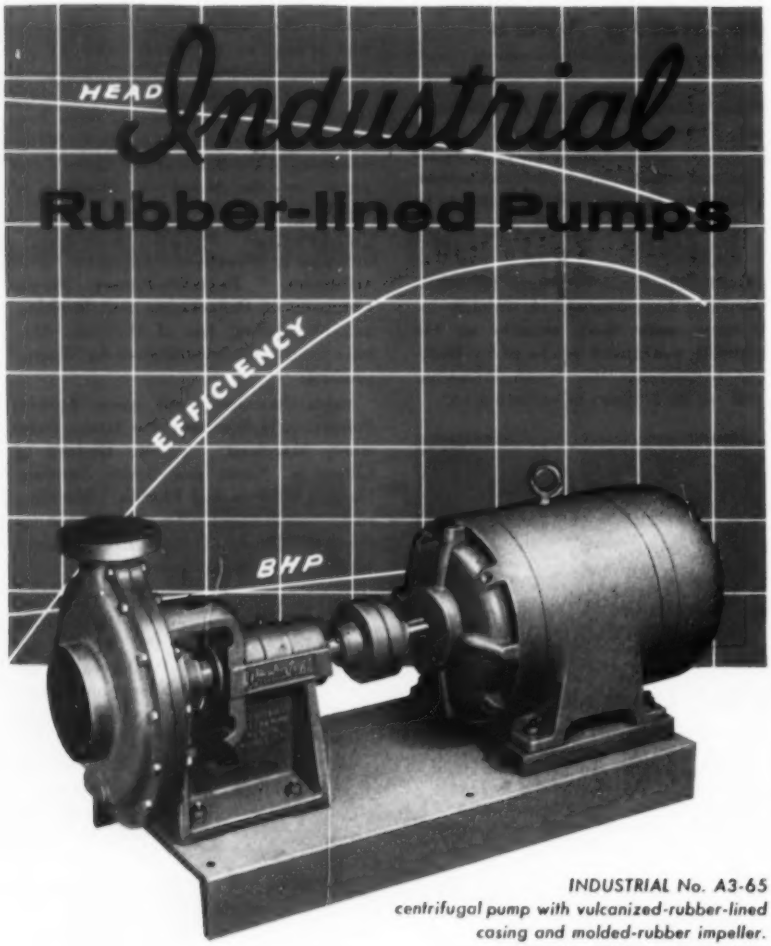
Pennsalt, for more than 20 years the only domestic producer of this chemical, placed in operation last month a new plant as part of its Wyandottte, Mich., Works.

Anhydrous ferric chloride is used widely in sewage and water treatment, serves as a catalyst in the manufacture of certain organic chlorides and as an etchant in photoengraving.

Product Name Change. Enthone, Inc., New Haven, Conn., announces a change in the name of one of their standard products. "Enthol" is the new name of the product formerly sold as Enthone Compound 42. This product is an acidic solvent type cleaner utilized for many years by many concerns for the combined cleaning and phosphating of iron, steel, zinc and aluminum surfaces prior to application of organic finishing materials. The product is exceptionally easy to use either as a wipe-on, brush-on or spray-on type of material. It also may be applied in diluted form by simple immersion. No complicated precleaning or after treatments are required.

Two Inventions for Automatic Spray Machines. Putting more "automatic" into automatic spray coating machines describes two new inventions, assigned to the company, of D. J. Peeps, engineering vice-president of the DeVilbiss Co., 300 Phillips Ave., Toledo 1, Ohio.

One invention is designed to move spray guns in synchronization with an article being sprayed and returning



INDUSTRIAL No. A3-65
centrifugal pump with vulcanized-rubber-lined casing and molded-rubber impeller. Base has rubber-covered floor.

for corrosive and noncorrosive liquids

The latest in pump engineering and design is incorporated in INDUSTRIAL centrifugal pumps for maximum efficiency and severe, continuous service. Lined with soft rubber for abrasive slurries or hard rubber as specified, balanced rotating assembly mounted in ball bearings, corrosion-proof stuffing box to permit external liquid seal if required, easily removable packing gland nut and ample space for repacking stuffing box, simple adjustment of impeller clearance are some of the features.

These pumps are made in a range of sizes with capacities up to 240 gpm., operating heads up to 240 feet, and ¾ to 15 hp. They are furnished either with or without base, motor, and coupling

Complete Information on Request 5150

INDUSTRIAL
FILTER & PUMP MFG. CO.
5914 Ogden Avenue • Chicago 50, Illinois

PRESSURE FILTERS
ION EXCHANGERS
RUBBER LININGS
HEAT EXCHANGERS
CENTRIFUGAL PUMPS

the guns to a starting position so another article can be coated in the same manner.

The invention aids in the maintenance of high production by making the return movement rapid and unvarying.

The other invention is a signalling device which is operated pneumatically. This device is designed to actuate the spray guns when an article is present on the conveyor supports of the automatic machine. If the support is empty, the device will not actuate the gun. The operation of the signalling device is dependable in transmission because of the pneumatic operation.

Kosmos Electrofinishing Research Inc. has started operations at 13 Valley St., Belleville, N. J. The new firm will conduct research in supplementary conversion coatings for such metals as zinc, cadmium, aluminum, tin, copper and their alloys. In addition, Kosmos will feature plating consultant services in industrial plating and finishing, solution control and corrosion testing.

Kosmos

J. Kosmos, president and chemist of the company, is a member of AES, the Electrochemical Society and the American Chemical Society. He formerly was associated with Pratt & Whitney, Underwood Corp., and was more recently with The Chemical Corp. as research and technical service chemist.

Other members of the corporation include Evans C. Sperry and Peter G. Ellis.

POSITION WANTED
PLATING ENGINEER

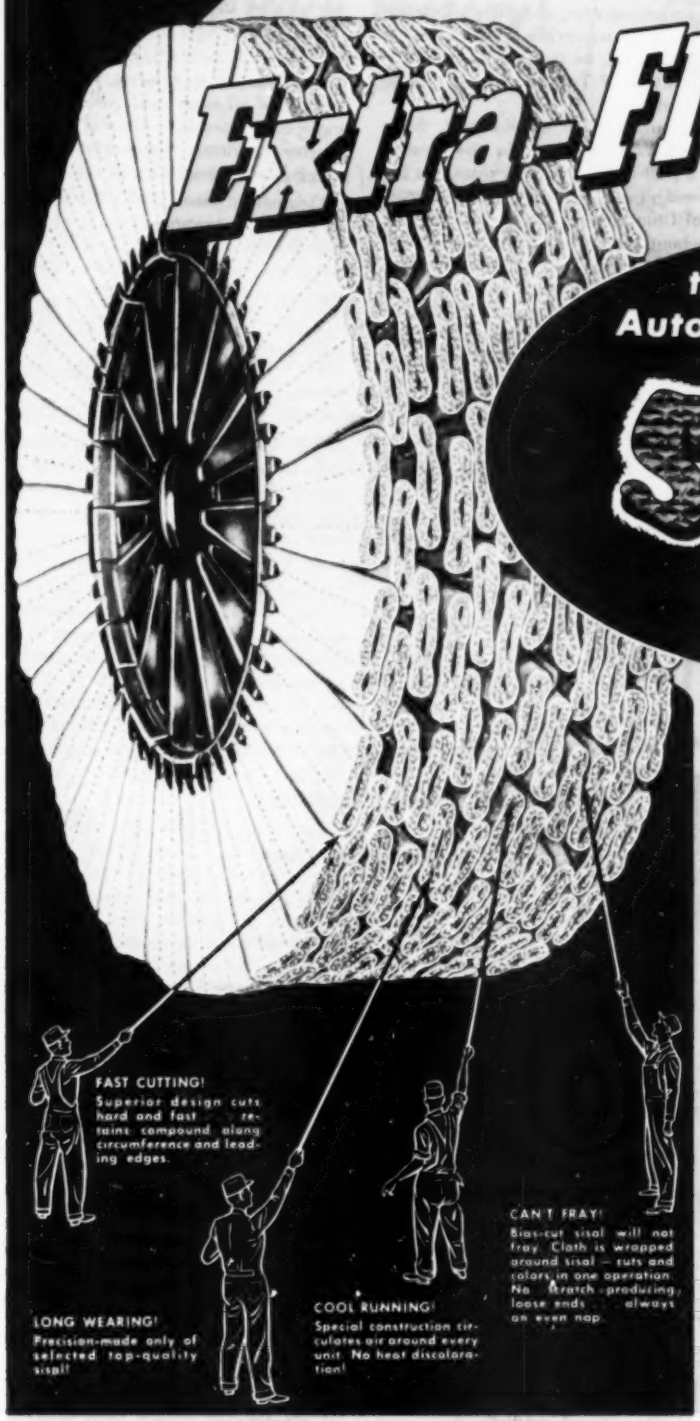
Technical and supervisory experience in all phases of plating, anodizing, and rustproofing. Have background in union negotiation, customer relations, personnel, production and purchasing. Metallurgical Engineering Graduate. Desirous to relocate in south, salary commensurate. Available for personal interview or will send resume. *Reply to:*

P-854-D, PLATING
445 Broad St., Newark 2, N. J.

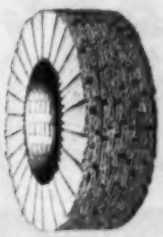
Here's the BUFF that's

Extra-Flexible

the Automatic UNIT SISAL BUFF


FAST CUTTING!
Superior design cuts hard and fast . . . retains compound along circumference and leading edges.
LONG WEARING!
Precision-made only of selected top-quality sisal!
COOL RUNNING!
Special construction circulates air around every unit. No heat discoloration!
CAN'T FRAY!
Bias-cut sisal will not fray. Cloth is wrapped around sisal — cuts and colors in one operation. No scratch-producing, loose ends . . . always an even nap.

Flexibility is the answer to an important buffing problem. Namely —how to get into crevices and odd-shaped contours. The Automatic Unit Sisal Buff provides just such flexibility . . . for speeded-up, quality production on both flat and curved jobs. Still another advanced "Automatic" design from American Buff!



Avai'able in both "air-conditioned" permanent center model and patented Centerless construction.

Write today for FREE BUFF-SELECTOR WALL CHART
(Sent to buff users only)

Automatic Buff Co.
Division of

American Buff Company

2414 South La Salle Street
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Phone CAlumet 5-1607

Personals

C. M. Knights has been appointed special representative for the Detroit area by the Hanson-Van Winkle Munning Co. At the same time, H-VW-M appointed **J. D. Kershaw,** new district manager of Michigan, **Calvin E. A. Solla,** district manager of Ohio; **Hilton M. Smith,** new sales representative for the Boston area; and **Eugene G. Gwyer,** sales engineer for the Michigan-Ohio area with headquarters in Detroit.

Knights, formerly district manager of Michigan, will concentrate on direct selling with automotive accounts in the Detroit territory. A member of the AES, he has been with H-VW-M for 25 years.

Kershaw moves to Michigan from Ohio, where he was district manager of the state. He joined H-VW-M in 1945, and served, prior to his Ohio appointment, as the company's western Michigan sales representative for 8 years. Before joining H-VW-M, Kershaw spent 4 years with an automotive company where he was a plating supervisor. Also a member of the AES, he is a graduate of Illinois Institute of Technology with a B.S. in chemistry.

Prior to his Ohio appointment, Solla was H-VW-M salesman in the Boston area, a post he held for 2½ years. In his new assignment, he will cover north-central Ohio himself and direct activities throughout the state from his new Cleveland headquarters. An AES member, he is an engineer graduate of Lafayette College.

Smith, a new member of the sales staff, will work out of the Boston office. He will cover Rhode Island, eastern Massachusetts, New Hampshire and Maine. Smith joined H-VW-M in January, coming to the company after 6 years of sales experience. A graduate of New Jersey State Teachers College, he has taken postgraduate studies in chemistry at Monmouth Junior College and Rutgers University.

Gwyer will assist the 6 H-VW-M salesmen in his 2-state area in the sales engineering of all equipment projects involving special attention. He will use his extensive experience in conveyor sales engineering by concentrating in that activity.

Originally trained in the H-VW-M laboratory in Matawan, Gwyer has been engaged since joining the company as an equipment and conveyor sales engineer working out of the home office.

A native New Yorker, Gwyer attended Seth Low Junior College in Brooklyn. He is a member of the American Electroplaters' Society.

W. E. Noyes, vice-president in charge of sales for The Diversey Corp., Chicago, announced the promotions of 5 men to new key sales positions within the Diversey sales department.

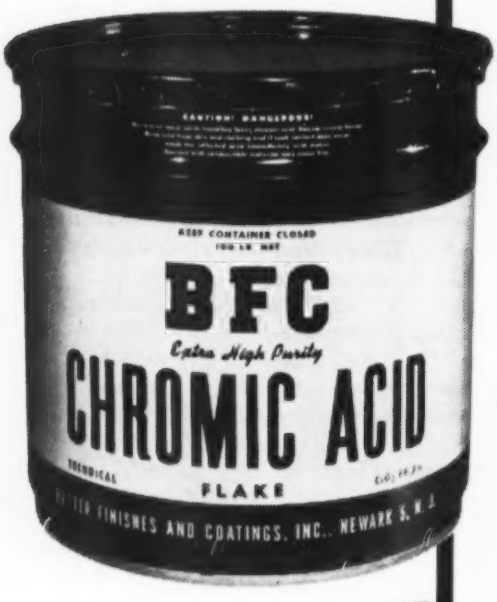
R. J. Stell was named manager of new product development, a newly created position; **C. R. Reid** was promoted to assistant general sales manager; **E. M. Petrie** has been appointed manager of the technical service department; **M. J. Butler, Jr.,** was named advertising-sales promotion manager; and **H. M. Pickles, Jr.,** has been appointed assistant to Noyes.

Sam Laud, who has been with the General American Transportation Corp., Chicago, Ill., for 38 years and president since 1945, became vice-chairman of the board. **William J. Stebler,** formerly executive vice-president, became the new president. Stebler, who served for 8 years as vice-president in charge of manufacturing prior to his promotion to executive vice-president in 1951, has been associated with the company since 1928. A new vice-president in charge of the plastics division is Frank E. Selz, who has been assistant to the president since 1945.

Other new officers include **Herman Altschul,** who will be vice-president in charge of freight car sales, and **James S. Frey,** who was elected a director of the corporation at the annual meeting, vice-president in charge of manufacturing. **Spencer D. Moseley** was named assistant to the president.

The company, whose original and principal business is the building, leasing and operating of railroad tank cars and other special purpose freight cars, lately has become an increasingly important factor in a number of other service and manufacturing fields, including the design, manufacture and erection of storage tanks

looks good-
is good



First thing you notice about BFC Chromic Acid is its shiny cherry-red color as it comes off the flaker. It looks good and it is good. Its chemical analysis is as fine as its physical appearance.

Our plant is modern; beautifully equipped; operated by men who are real proud of the product they make. Your orders will get personal attention of owner-managers who value your business. When you are in the market, why not call us?

BETTER FINISHES & COATINGS, INC.

268 Doremus Avenue, Newark 5, N. J.

122 East 7th St., Los Angeles 14, Calif.

The BIGGEST Time and Money Savers in Plating Rack History!

Racks for any job when you need them.
No delay—no waiting.

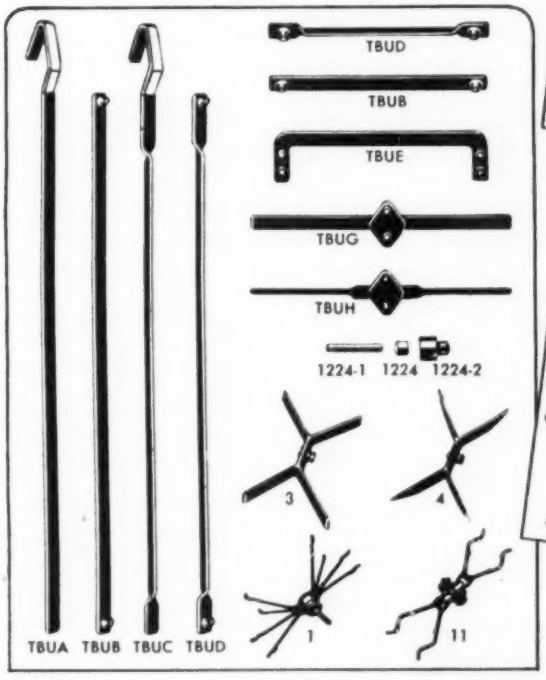
Quick and easy conversion.
Racks easily changed to fit different jobs—you can have top efficiency on every job.

Replaceable Tips for easy tip upkeep.
Enable you to keep every rack at full capacity.

Tremendous saving in plating rack costs.
You can make new racks designed for the job from members of discarded Thinker Boy Racks at the mere cost of assembly.

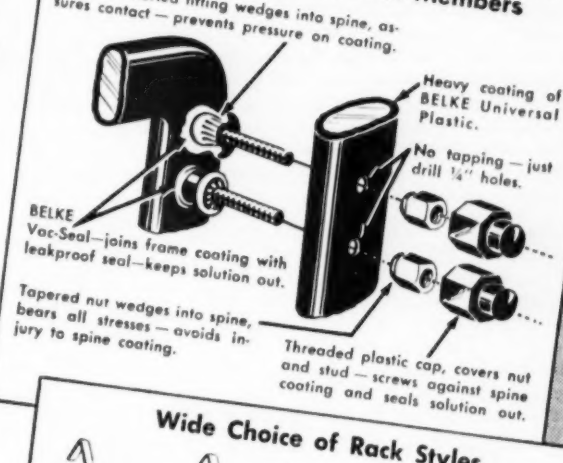
No added investment necessary. *Here's how you can cash in on the tremendous time and money saving economy of Thinker Boy Racks without investing an extra dime.*

1. When you need racks get *Thinker Boys.* Vac-Seal replaceable tips enable you to keep every Thinker Boy Rack at full capacity.
2. When Thinker Boy Racks of one design are no longer needed, convert them to a design you need or disassemble and store the parts.
3. When you need racks for a different job, assemble them from your stock of used Thinker Boy Parts. You get racks designed for the job in a matter of minutes for the mere cost of assembly.

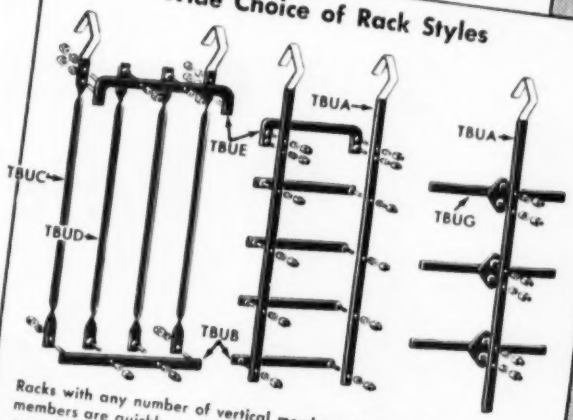


Thinker Boy Precoated Vac-Seal Parts are mass produced for low cost and carried in stock for prompt shipment. Furnished in any assortment or assembled to your specification. Ask your BELKE Service Engineer or write for descriptive bulletin and parts list.

LEAKPROOF ASSEMBLY of Thinker Boy Precoated Plating Rack Members

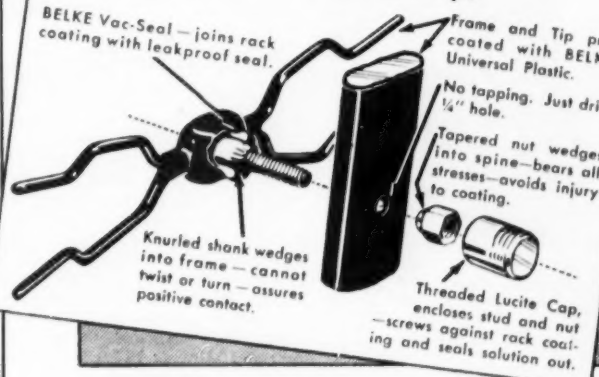

Tapered knurled fitting wedges into spine, assures contact — prevents pressure on coating.
Heavy coating of BELKE Universal Plastic.
No tapping — just drill ¼" holes.
BELKE Vac-Seal—joins frame coating with leakproof seal—keeps solution out.
Tapered nut wedges into spine, bears all stresses — avoids injury to spine coating.
Threaded plastic cap, covers nut and stud — screws against spine coating and seals solution out.

Wide Choice of Rack Styles



Racks with any number of vertical members, horizontal members or T members are quickly assembled from a small selection of Thinker Boy precoated Vac-Seal Parts—¼" drill and pliers are only tools needed.

LEAKPROOF MOUNTING of Vac-Seal Precoated Tips


BELKE Vac-Seal — joins rack coating with leakproof seal.
Frame and Tip precoated with BELKE Universal Plastic.
No tapping. Just drill ¼" hole.
Tapered nut wedges into spine—bears all stresses—avoids injury to coating.
Knurled shank wedges into frame — cannot twist or turn — assures positive contact.
Threaded Lucite Cap, encloses stud and nut —screws against rack coating and seals solution out.

Belke MANUFACTURING CO.
947 N. Cicero Ave.
Chicago 51, Ill.

EVERYTHING FOR PLATING PLANTS

Personals

and pressure vessels; manufacture of process equipment for the chemical, and other industries; plastics—in which General American is the nation's leading producer of molded parts; chemical nickel plating—through its recently developed Kanigen process; and the manufacture of self-tapping screws and other quality control fasteners through its recently acquired Parker-Kalon Division.

Kenneth G. LeFevre, a graduate of the University of Pennsylvania, who was connected formerly with a chemical firm in the Chicago area, has been appointed to the sales engineering staff of the protective coatings division of Metalweld, Inc., Philadelphia. **Joseph H. Briscoe,** who studied engineering at the University of Tulsa and was also on the staff of a chemical organization, is another appointee to that division.

Both men will handle the sale of synthetic coatings, rubber linings, metalizing, and specification coatings in the New England, eastern and southern territory serviced by Metalweld.

Robert L. Giesel, president of Adolph Plating, Inc., 334 N. Bell Ave., Chicago, has been elected to membership in the Young Presidents Organization. The YPO is a business group made up of nationally recognized executives who have, at the time of their election, not yet attained the age of 40, but who have demonstrated their leadership qualities in rising to the presidency of their respective companies.

Harry Sirovy has been promoted to the post of sales manager, and **Harold La Casse** has been appointed service manager of the chemical division of the Essak Steel & Chemical Co., 4013 Milwaukee Ave., Chicago 41, Ill. Sirovy, who has been with Essak since 1950, was formerly with Century Vitreous Enamel Product Co. LaCasse was formerly with Pennsylvania Salt Manufacturing Co. The appointments were made to expand the company's operations in the metal cleaning field.

Jack H. Senger has been appointed by the Udylite Corp., as sales engineer in

Senger

the Detroit area. Senger was previously in the plastics division. He will service the area from the Detroit office at 1651 E. Grand Blvd.

Dr. William A. LaLande, Jr., was elected vice-president of the Pennsylvania Salt Mfg. Co., and will continue as manager of research and development. **Edward F. Beale,** also named a vice-president, is treasurer of the company.

Dr. LaLande, a graduate of the University of Pennsylvania, joined Pennsalt in 1944, and has been directing Pennsalt's research and development program at Wyndmoor, Pa., since 1948.

Beale attended the William Penn Charter School and is an alumnus of Princeton University. In 1946, he joined Pennsalt as assistant to the treasurer and was named controller in 1948 and secretary and treasurer in 1951.

Also announced was the election of 4 financial officers.

Stanley L. MacMillan and **R. Visscher Millar** were re-elected assistant treasurers. **Eugene J. Harrington, Jr.,** formerly assistant secretary and assistant treasurer, will succeed Beale as secretary and continue to serve as an assistant treasurer. **Frederick J. Emmenegger** becomes controller.

Alfred H. Pope, formerly a member of the Pennsylvania Salt Manufacturing Company's technical department staff, has been named product supervisor for Pennsalt's metal cleaners and will be replaced by **William T. West** of the metal processing department's sales organization.

In his new position, Pope will be responsible for the company's sales and service activities in the metal cleaners industry. He is an alumnus of Pratt Institute where he majored in chemical engineering. Pope

guard against Rejects

"Sealed-Disc" Filters were designed especially for plating rooms. They're smaller, compact, and more portable than ordinary conventional Filters, and they are also performing satisfactory results on many acid dips, electro cleaners and solvents.

You can be sure with a "Sealed-Disc" Filter

More and more cost-minded platers depend on Alsop *"Sealed-Disc"* Filters to remove dirt, dust, and sludge from their plating solutions. They get better finished plated work, they save time and labor, and their plating solutions last longer. The *"Sealed-Disc"* Filter assures positive, trouble-free performance that's proof against even the invisible impurities that cause nodules and porousness, proof against rejects and reworking. There's a *"Sealed-Disc"* Filter *"to fit your job"*—write for complete information, the Alsop Engineering Corporation, 908 Fine Street, Milldale, Connecticut.

ALSOP ENGINEERING CORPORATION

Filters, Filter Discs, Pumps, Tanks, Mixers, Agitators

Specialists in Industrial Cleaning Products

"Use Cost" buying can save you money!

Do you buy your cleaning products by "price per pound" or by actual "use cost"?

If you want the most value for your money, it will pay you to buy on the basis of performance and "use cost." Cheap products often cost *more* in the long run.

Wyandotte is a basic producer of high-quality, specialized cleaning products for industry. Experienced Wyandotte field men have the products and know-how to make cost-saving suggestions for *your* operations. Mail coupon today! *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Nietos, California.*

Helpful service representatives in 138 cities in the U.S. and Canada

WYANDOTTE CHEMICALS CORPORATION
Department 2267, Wyandotte, Michigan

I'm interested in low "use cost" cleaning compounds. Please have your man call and make cost-saving suggestions.

NAME _____

FIRM _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

Personals

joined Pennsalt in 1943 as a member of its research and development staff.

West has been associated with the company as sales representative for the New York area since 1951, and like his predecessor, is well known in the metal finishing field.

To fill West's old post, **J. Richard Relick** has been appointed sales representative for Pennsalt's metal processing chemicals in the New York City, Newark and northeastern Pennsylvania territory.

Robert M. Burford has been named sales supervisor of the newly created Buffalo district for the metal processing department of the company.

Burford's territory will include New York state, eastern Ohio, northeastern Pennsylvania, and northern New Jersey.

Obituary

✣ **John E. Sterling,** Past President of the AES and one of the Society's pioneers, died at his Paterson, N. J., home on June 18 after a prolonged illness. He was 79.

Born in New York City, he attended schools there and in Oswego. He was first employed in the polishing room of Seliger and Toothill Novelty Company of Oswego and prior to his retirement in 1949, he was employed by C. A. Lansberg of Paterson, N. J.

Sterling was a veteran of the Spanish-American War. One of the mainstays of the AES, he held top national and New York Branch offices. He was one of the few who held the coveted Honorary AES Membership for outstanding contributions to the Society.

Sterling

Among the many friends and relatives who attended the funeral were Past President F. J. MacStoker, representing the AES Executive Board, and members of the New York Branch: President A. Amatore, Secretary G. Schore, I. Goldwasser and A. Fusco and AES Executive Secretary P. Kovatis.

A devoted friend, husband and father, Sterling was loved by all who knew him. He leaves a Society which he helped to make great, his wife, Mrs. Viola Sterling of Paterson, N. J., and two daughters, Mrs. Marguerite Schroeder of Paterson and Mrs. Lillian Crouch of Oswego, N. Y.

Intersociety News

American Society for Testing Materials Officers 1954-55

At the 57th Annual Meeting held in Chicago, June 13-18, the following men were elected as the new officers of the American Society for Testing Materials for the ensuing year: President, Norman L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia, Pa.; Vice-President, Rudolph A. Schatzel, Vice-President and Director of Engineering, Rome Cable Corp., Rome, N. Y.

The following were elected to the Board of Directors: Edward J. Albert, President and Treasurer, Thwing-Albert Instrument Co., Philadelphia, Pa.; John M. Campbell, Administrative Director, Research Laboratories Division, General Motors Corp., Detroit, Mich.; Paul V. Garin, Engineer of Tests, Southern Pacific Co., San Francisco, Calif.; John H. Jenkins, Chief, Forest Products Laboratories of Canada, Ottawa, Ont., Canada; Douglas E. Parsons, Chief, Building Technology Division, National Bureau of Standards, Washington, D. C.

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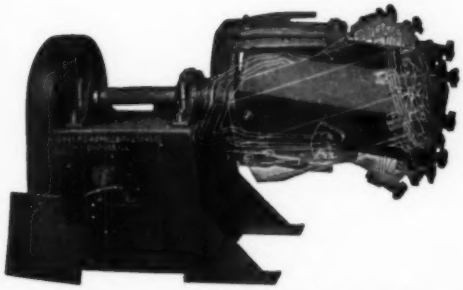

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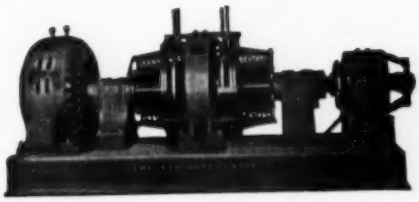

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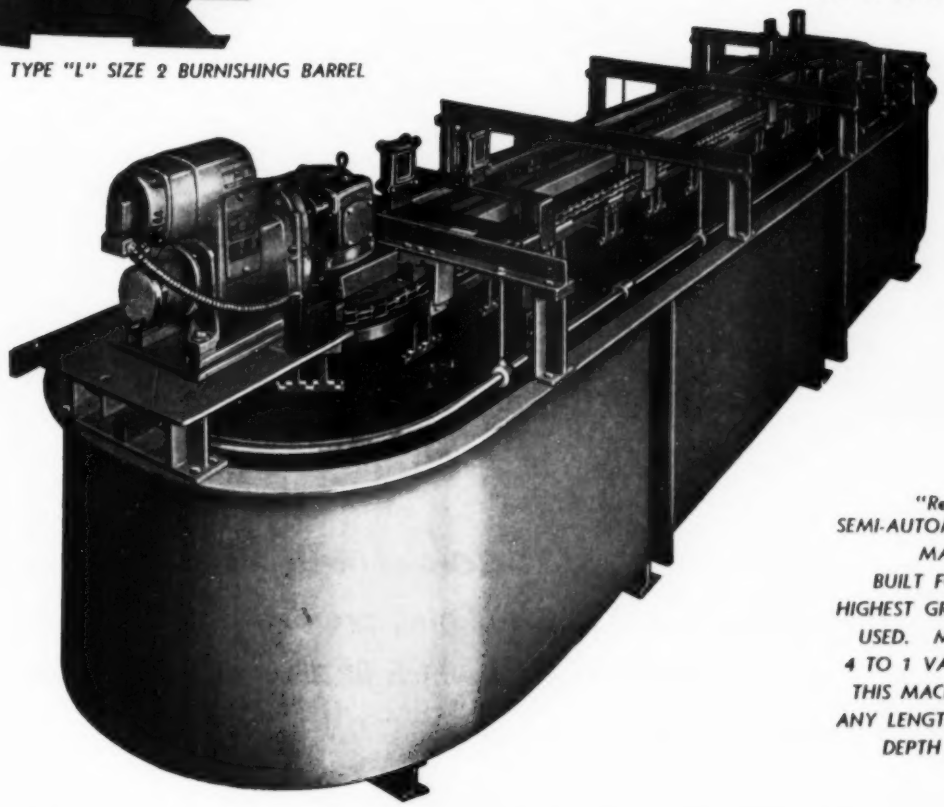

"Reliance" SEMI-AUTOMATIC PLATING MACHINE BUILT FOR SERVICE HIGHEST GRADE MATERIAL USED. MOTOR ½ HP 4 TO 1 VARIABLE SPEED. THIS MACHINE IS BUILT ANY LENGTH, WIDTH AND DEPTH OF TANK.

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***Each* of these new outstanding Harshaw bright nickel plating processes have certain unusual characteristics which fit them to the product finish required in your plant.**

Top brightness with thin deposits . . . Especially outstanding color performance in applications where little or no basis metal finishing is done prior to plating. . . . Perglow or Nubrite deposits are extremely receptive to chrome plating . . . Unique leveling results of Perglow or Nubrite have a hiding and filling effect on surface defects which other nickel deposits tend to emphasize. Polishing costs are decreased.

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Pittsburgh 22, Penna. • New York 17, N. Y.

Trade Literature

L-800. Maintenance Cleaning Guide—How-to-do-it charts based on actual in-plant maintenance procedures are a feature of the new "Plant Maintenance Cleaning Guide" recently published by Oakite Products, Inc.

Designed for quick reference, the charts list recommended cleaning materials, methods of application, concentrations and temperatures for such specific operations as cleaning, and treating the water in, air conditioning and refrigeration units; cleaning compressors and condensers; descaling diesel water jackets and water-cooled furnaces; cleaning floors, oil heaters and coolers, windows and light fixtures; controlling mold and odors; stripping paint from machinery and transformers; and removing rust. The booklet also describes Oakite cleaning materials, Oakite Solution-Lifting Steam Guns, and the Oakite Hot Spray Unit.

Copies of this compact, handy, 12-page booklet are available by using Reader Service Card.

L-801. Reinforced Grinding Wheels—A new 28-page catalog describing its reinforced resinoid line of grinding wheels recently has been issued by Norton Co.

This liberally illustrated booklet contains typical application photographs, tables of wheel sizes, prices, operating speeds and other data. Scores of portable grinding operations are listed together with the recommended wheel specification.

Wheels discussed in this booklet are Norton's BN type straight cutting off wheels for removing gates and risers, slotting and cutting firebrick; BD type hub wheel for weld grinding, cleaning castings, removing rust; BFR type reinforced hub wheel for work requiring flexibility for removing mold marks on castings, smoothing welds on auto bodies, preparing cast surfaces for painting and removing rust; and the BF reinforced straight wheels for burring, removing flash from plastic parts, removing marks from turned parts, and miscellaneous light portable and bench grinding operations.

"BN—BD—BFR—BF Reinforced Resinoid Products," catalog 1748 may be obtained by using Reader Service Card.

L-802. Plating Rectifiers—A new 8-page, 2-color, illustrated bulletin No. 5500 contains helpful hints on installations of plating rectifiers, describing different arrangements best suited for certain installations. Descriptive photographs are included to demonstrate the different arrangements. Valuable information concerning the desirable features of top-quality rectifier construction is outlined in detail. It shows the new dripproof laboratory models together with a complete description of the other various types of rectifiers that are available for electroplating and anodizing. The bulletin also gives a brief discussion of the history and present facilities of the Ther Electric & Machine Works publishers of the bulletin. For more information, use Reader Service Card.

L-803. Guide to Finishing and Plating Racks and Tips—A free 24-page catalog providing a ready source of information on racking methods and tip constructions for plating and finishing has been released by NARACO.

The book describes fundamental tip or work holder forms and basic racking procedures. It is meant to constitute a background for suggesting the correct approach to any specific problem.

To obtain a copy use Reader Service Card.

L—804. Continuous-Cast Bearing Bronze Described in New Asarco Bulletin—How Asarcon 773 continuous-cast bearing bronze (SAE 660) saves money in factory maintenance and production by virtue of the unique advantages the product offers in length, size, machining time, metallurgical characteristics, and physical properties is explained in a new 6-page bulletin just published by the continuous-cast products department of American Smelting and Refining Co., Barber Station, Perth Amboy, N. J.

The bulletin also describes in detail the patented Asarco continuous-cast process

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..get ALL these results!

1. **FAST, EFFECTIVE CLEANING** insured by the ability of the cleaning solution to carry high current densities.
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4. **DOUBLE-ACTING RESULTS** from a cleaner that works chemically as well as electrolytically.
5. **NO ATTACK ON METALS** by making sure that your cleaner is safe for the metals you process.

Magnus makes a complete line of Electro-Cleaners. You can get ALL these results on *your* work by using the Magnus material that has demonstrated its superiority on aluminum, soft metals, die cast, steel or combinations of any of these metals.

The Magnus laboratory is always ready to make test runs on your particular metal units to determine which Magnus Electro-Cleaner is best suited to your work.

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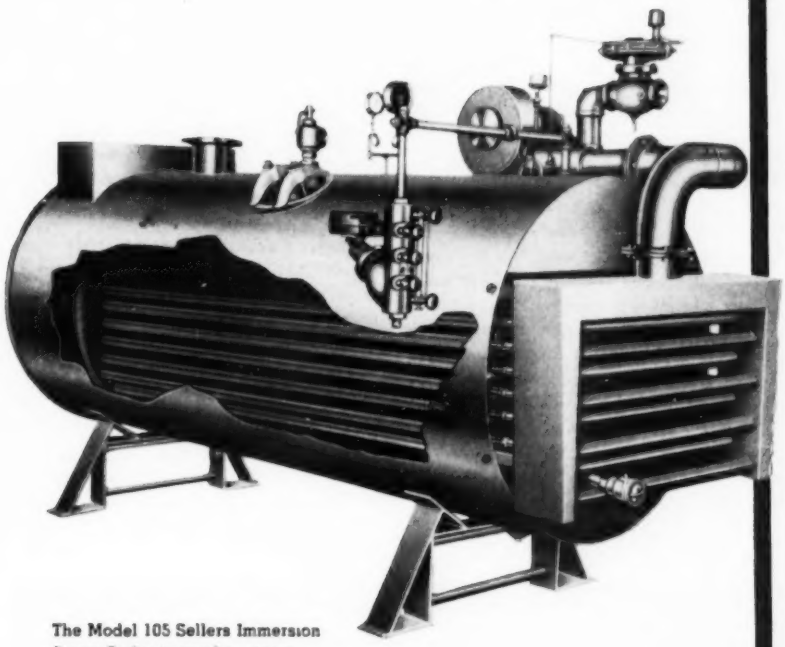
There's a good reason why

SELLERS BURNS GAS "INSIDE THE WATER"



The Model 105 Sellers Immersion Steam Boiler is another steam boiler designed and built with totally submerged and horizontally located firing tubes.

This system of firing permits all gas to be burned inside the submerged tubes — and therefore *inside the water.*

Every tube is an individual combustion chamber with its own burner — *completely surrounded by water.* This is the most efficient method ever devised.

And this system permits "spreading out the fire" — to put every square foot of heating surface to work, increasing life, internal circulation, and operating efficiency.

The Sellers Model 105 Immersion Steam Boiler is only one of a complete line — all are companion boilers to the famous Sellers Model 46. Investigate this line — there is one to fit your requirements.

BEFORE YOU BUY ANY STEAM BOILER, CONSIDER THESE FACTS

- ***MINIMUM SCALE PROBLEM***
  Intermittent firing of the boiler brings about alternate expansion and contraction of the firing tubes which loosens scale which might form on the tubes. This scale drops to the bottom of the shell out of the firing zone and cannot bake on to the firing tubes. Clean out openings are provided.
- ***CONTINUED HIGH EFFICIENCY***
  As long as firing tubes are kept clean, original high efficiency is economically maintained.
- ***NO WATERLINE CORROSION***
  With all firing tubes totally submerged, there is no corrosion at the waterline—where tubes normally fail. In Sellers immersion type steam boilers, there can be no waterline corrosion.
- ***MORE EFFECTIVE INSULATION***
  More effective insulation is possible because the insulation is against heat loss from low temperature steam and water instead of a high temperature combustion chamber.
- ***FASTER STEAMING AND DRYER STEAM***
  Rapid steaming and dry steam takes place because of the large surface area of the water. All surface water is heated first since the firing tubes are located close to the water line.

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Trade Literature

by which a variety of bronze alloys is cast into rods, tubes, and shapes of many different diameters and profiles. For your copy of the bulletin, use Reader Service Card.

L—805. Demineralization Bulletin—The most comprehensive editorial treatment ever accorded the subject of demineralization in a company publication is contained in a new, 24-page bulletin now offered by Graver Water Conditioning Co., 216 W. 14th St., New York 11, N. Y. Chemical and mechanical factors entering into the design and operation of demineralizing plants for obtaining the highest quality process water and boiler feedwater from a wide range of water supplies and under many different operating conditions are explained fully.

How the removal of ionized, dissolved solids from water by means of ion exchange assures trouble-free operation of many types of equipment, and how it aids in the improved manufacture of such products as fine chemicals, plastics, mirrors, television tubes and metal plated parts are described. For your copy of the bulletin, use Reader Service Card.

L—806. Bulletin on Reinforced Grinding Discs—A new bulletin describing Manhattan moldiscs for portable grinders and sanders has been issued by the Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J. The fully illustrated bulletin contains helpful application data and lists advantages claimed for this safety wheel with photos of different types of work. Sizes, grades and recommended operating speeds are listed also. Copies may be obtained by using Reader Service Card.

L—807. Leak-Proof Quick-Seal Hose Coupling—A quick connect-disconnect hose coupling for water, oil, steam, gas and chemical lines, which provides permanent freedom from leakage, is described in a bulletin just published by Titeflex, Inc., Hendee St., Springfield 4, Mass.

The 16-page booklet describes the simple construction of the coupling and points out how this construction provides: (1) a unique sealing action which makes the coupling tighter as internal pressure increases, thereby insuring freedom from leakage even at high pressures and (2) a swiveling action that prevents hose twisting and kinking, thereby insuring long hose life. For a copy of this descriptive booklet, use Reader Service Card.

L—808. Vinyl Rigid Sheets—Detailed technical data for product designers and fabricators on "Bakelite Plastics—Vinyl Rigid Sheets" is available in a new booklet issued by Bakelite Co., a Division of Union Carbide and Carbon Corp., 300 Madison Ave., New York 17, N. Y. This 40-page reference handbook describes fully the forms, properties, fabrication techniques and application of vinyl plastic rigid sheets.

Laboratory test data presented in graphs and tables accurately record the material's useful properties. Sections on forming, machining, finishes, cleaning and polishing, and cementing and bonding these tough sheets reveal the latest improvements in technique for the fabricator. Copies of this booklet may be obtained by use of Reader Service Card.

L—809. Catalog On Airblasting and Sandblasting Nozzles—A new catalog describing its line of airblast cleaning nozzles has been published by American Wheelabrator & Equipment Corp., 1180 S. Byrkit St., Mishawaka, Ind. Three standard models of nozzles are described. Also included are pressure blast hose fittings for standard airblast nozzles.

Of special interest to cleaning engineers is the description of materials employed in the nozzles, and the discussion of how to control compressed air consumption.

AVOID COSTLY REJECTS DUE TO UNACCEPTABLE COATING THICKNESS!

For quality control and acceptance tests, measure thickness of coatings on metals the easy, accurate, non-destructive way, with the . . .

AMINCO BRENNER **MAGNE-GAGE**

Widely used by industry and government for accurately measuring the thickness of:

1. Non-magnetic coatings (metallic or non-metallic) on magnetic base metals.
2. Nickel coatings on magnetic or non-magnetic base metals.
3. Composite copper-nickel coatings on magnetic base metals.

Measures coatings on plane, convex or concave surfaces. Gives speedy and accurate results. Easy to use by non-technical personnel.

Coating on cylindrical object being measured with the Magne-Gage.

Avoids expensive rejections due to coatings that may be too thin, or non-uniform. Eliminates the expense involved in replating or discarding specimens spoiled by destructive tests . . . every piece tested is unharmed and ready for use or shipment. Saves materials wasted by coatings thicker than necessary. Its use leads to the discovery of faults that may exist in plating methods or equipment.

Write for Bulletin 2150-Y

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BETTER
Barrel Zinc Brighteners

PROMAT B4, B4M and B8

with

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- ✳ Low-cost Operation

Here's a simple, fast and *economical* method for producing brilliant zinc deposits on barrel work.

Promat B4, B4M and B8 Brighteners can be successfully treated with chromates, phosphates and other surface conversion coatings . . . are easily controlled, strike fast, cover well, and can be depended upon for uniform depth and brilliance of color.

. . . and there's more—most average cyanide zinc plating solutions can be readily and inexpensively converted to Promat B4, B4M or B8. Find out how, and why, these new brighteners can help ease your plating problems. Write for details.

PROMAT DIVISION

POOR & COMPANY
851 S. Market St., Waukegan, Illinois

Trade Literature

This is accompanied by tabular data showing the importance of controlling nozzle wear. Free copies of this catalog may be obtained by using Reader Service Card.

L—810. Folder on "Dip-Pak"—Fidelity Chemical Products Corp., of 470 Frelinghuysen Ave., Newark, N. J., has announced the release of their up-to-date 4-page leaflet detailing data on "Dip-Pak," a hot-melt plastic coating. Types of Dip-Pak are listed, including the base plastics, colors, physical properties, corrosion resistance, melting and application temperatures for each.

The folder explains the extra protection which Dip-Pak offers in safeguarding tools, gears, and precision parts from corrosion or damage as well as affording completely satisfactory protection to metal parts during storage and shipping. For your copy of this descriptive literature, use Reader Service Card.

L—811. Packaged Oil Recovery Units Described in Bulletin—Kleer-Stream automatic oil recovery units designed for use with parts washers, coolant sumps and reservoirs handling liquids containing oil are described in a bulletin issued by Detroit Harvester Co., Pioneer Pump Division, 14300 Tireman Ave., Detroit 28, Mich. Operation of the unit that recovers oil from a wide range of industrial liquids permitting its re-use and reducing the problem of stream pollution is covered in simple, nontechnical language.

A few of the Kleer-Stream operating features highlighted in the bulletin are: wide range of application, automatic operation, rapid separation, simple adjustment, high-capacity dual pumps, minimum maintenance, easy accessibility and use of safety interlocks. For your copy, use Reader Service Card.

L—812. Hard Chromium Plating Unit—An illustrated 4-page folder describes a new package unit for hard chromium plating of production tools and parts.

It tells how and why hard chromium is used in industry for great savings. Applications, advantages, uses are given also. Explained are the Morey Process features of precise control of plate deposition; superior throwing power; maximum adherence, density, ductility; identical duplication. For your copy, write to Wagner Brothers, Inc., 400 Midland Ave., Detroit 3, Mich., or use Reader Service Card.

L—813. Protection for Aluminum—A new folder has been issued on Brush "Alodine" No. 1200, the ACP protective coating chemical that greatly improves the corrosion-resistance of unpainted aluminum and forms a durable bond for paint. Brush "Alodine" No. 1200 is applied manually; meets the requirements of Military Specification MIL-C-5541.

Information in the folder should interest any readers who fabricate or work with aluminum products. For a copy of the literature, write to American Chemical Paint Co., Ambler, Pa., or use Reader Service Card.

L—814. Portable Temperature Indicators for Heavy-Duty Use—A new 8-page bulletin just issued by The Foxboro Co. of Foxboro, Mass., describes two portable temperature indicators, the potentiometer indicator and the resistance thermometer. These instruments are used by industry for periodic temperature tests to spot impending troubles in equipment such as heating units and test furnaces, which may not warrant continuous measurement.

Described in detail are operating adjustments, features of design, test circuits, measuring elements and instrument specifications. Tables also list the type of thermocouple or resistance bulb recommended for each temperature range, as well as the degrees of temperature indicated by each scale division.

Also covered is the use of portable pyrometers in checking installed pyrometric instruments and in replacing potentiometers which are temporarily out of service. For your copy of the bulletin, use Reader Service Card.

MUNRAY PC-11 REDUCES PLATING COSTS IN NICKLE-PLATING PROCESS

Used to coat the Forcite Anode Baskets in a full-automatic nickle-plating machine, MUNRAY PC-11 has been subjected to continuous, round-the-clock operation for 3 years. It has required no maintenance, and is still in "as new" condition.

MUNRAY PC-11 is immune to the effects of plating solutions and is absolutely non-contaminating. It features high tensile and dielectric strength and provides a resilient, abrasion resistant coating for racks, baskets, pails, screens, piping, etc.

100% solids content of PC-11 gives maximum surface coverage. This feature, combined with its long, maintenance-free service life, makes MUNRAY PC-11 the highest quality, most economical protective coating available for plating applications.

For further information, fill in coupon and send today to MUNRAY.

MUNRAY corrosion protection for industry

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Send additional information on MUNRAY PC-11

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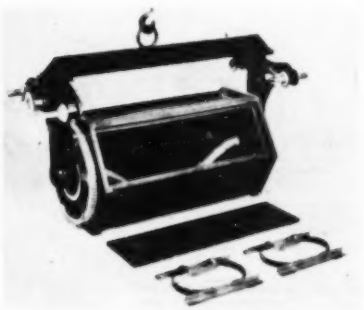
CUSTOM FORMULATED PLASTISOLS — PROTECTIVE COATINGS — TANK LININGS — PLASTIC PIPE AND TUBING

Equipment and Supplies

E-815. New Barrel Plating Equipment—The development of a new plating barrel with a cylinder made of Tempron hard rubber has been announced by the Udylite Corp. of Detroit. With this new material and specially designed construction, the new cylinder offers advantages previously impossible.



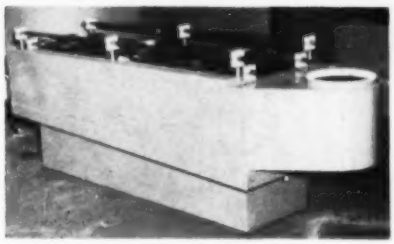
It is claimed that Tempron withstands, even under load, higher temperatures than have been possible to use with any thermo plastic material. Udylite Tempron cylinders can be used most effectively through the entire plating cycle and it is said, have better abrasion and acid resistance. The new design and construction offer greater strength than even the one piece construction because of an ingenious system of interlocking panels and ribs.

A Teflon liner or membrane with very small perforations, smaller than can be obtained by conventional drilling methods, also is offered. This liner can be installed in the new cylinder with only minor modifications. For more information, use Reader Service Card.

E-816. New Metal Cleaner—Development of a new type of prephosphating metal cleaner to be used in mechanical spray processing equipment, which is relatively neutral and contains no metallic activator, is announced by the Detrex Corp. of Detroit.

Detrex 771 Paintbond cleaner was designed specifically for use in spray phosphate coating units where a fine-grained phosphate crystal is required. By accomplishing the activating process without resorting to metallic activators, Detrex 771 leaves the metal surface chemically clean and requires no surface seeding in the prephosphate coating stages.

Subsequent phosphate coatings are extremely fine grained and uniform which, it is claimed, results in lower chemical consumption. Use Reader Service Card for additional information.



STORTSWELDING on your tanks means longer life for linings

Non-metallic linings are preferred for certain conditions of operation. High first cost makes it vital to be sure of the tank that's under the lining—be sure that it is soundly double-welded, smooth, spatter-free and altogether dependable. Tanks for linings are a Storts specialty—Storts weldmen follow engineered procedures to make sure that you get full normal service life from your linings.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 925.

These chromium plated door-knobs are on display at the Chandler Chemical Museum, Columbia University, New York.

The year 1924 marked a significant new development in metal finishing—a commercial process for Chromium Plating. The door knobs referred to above were the first objects so plated and were installed on the door of Dr. Fink's laboratory where they remained in service for many years.

The immediate demand for chromium plated metal which arose as a result of the new process added another important product to Mutual's list of chromium chemicals, namely, Chromic Acid. Today, the Mutual trade mark on Chromic Acid drums is known and respected wherever chromium plating is performed.

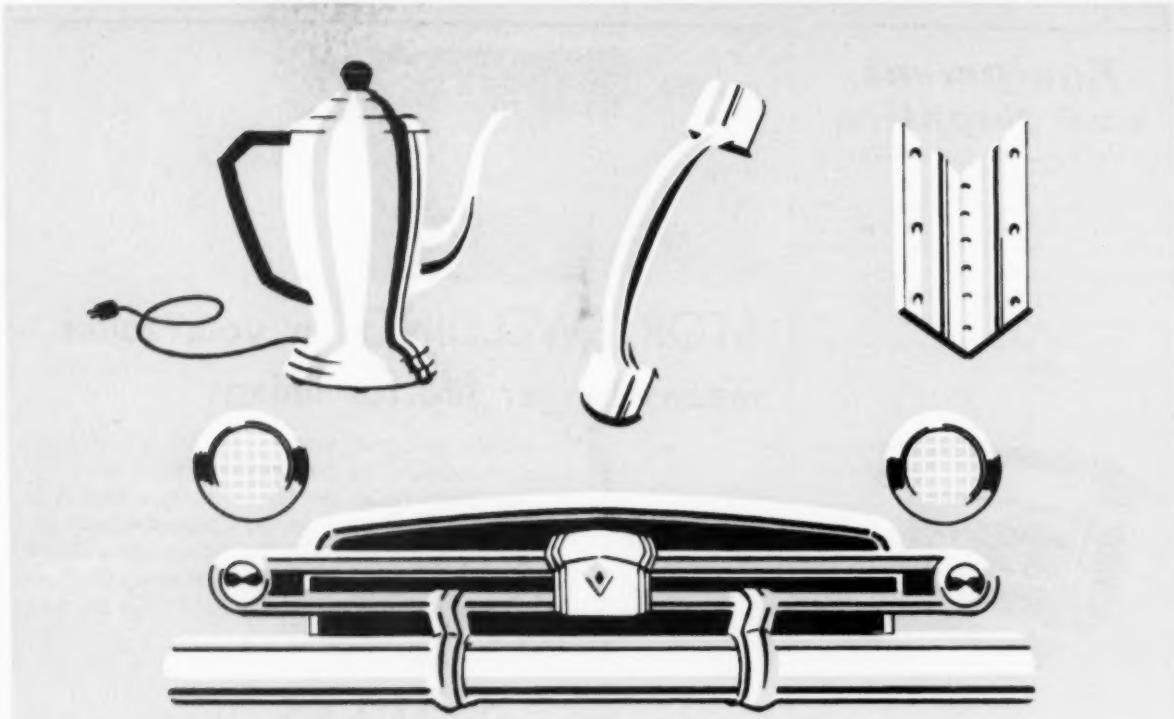
CHROMIC ACID *SODIUM BICHROMATE* *POTASSIUM BICHROMATE*

MUTUAL CHEMICAL CO. OF AMERICA

Mutual Chromium Chemicals

99 Park Avenue, New York 16, N. Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 926.



for all bright nickel applications

Designed to be flexible, The McGean Bright Nickel Plating Process is suitable for all your bright nickel plating applications. With McGean Bright Nickel you benefit by improved performance . . . solve many production headaches . . . obtain lower costs.

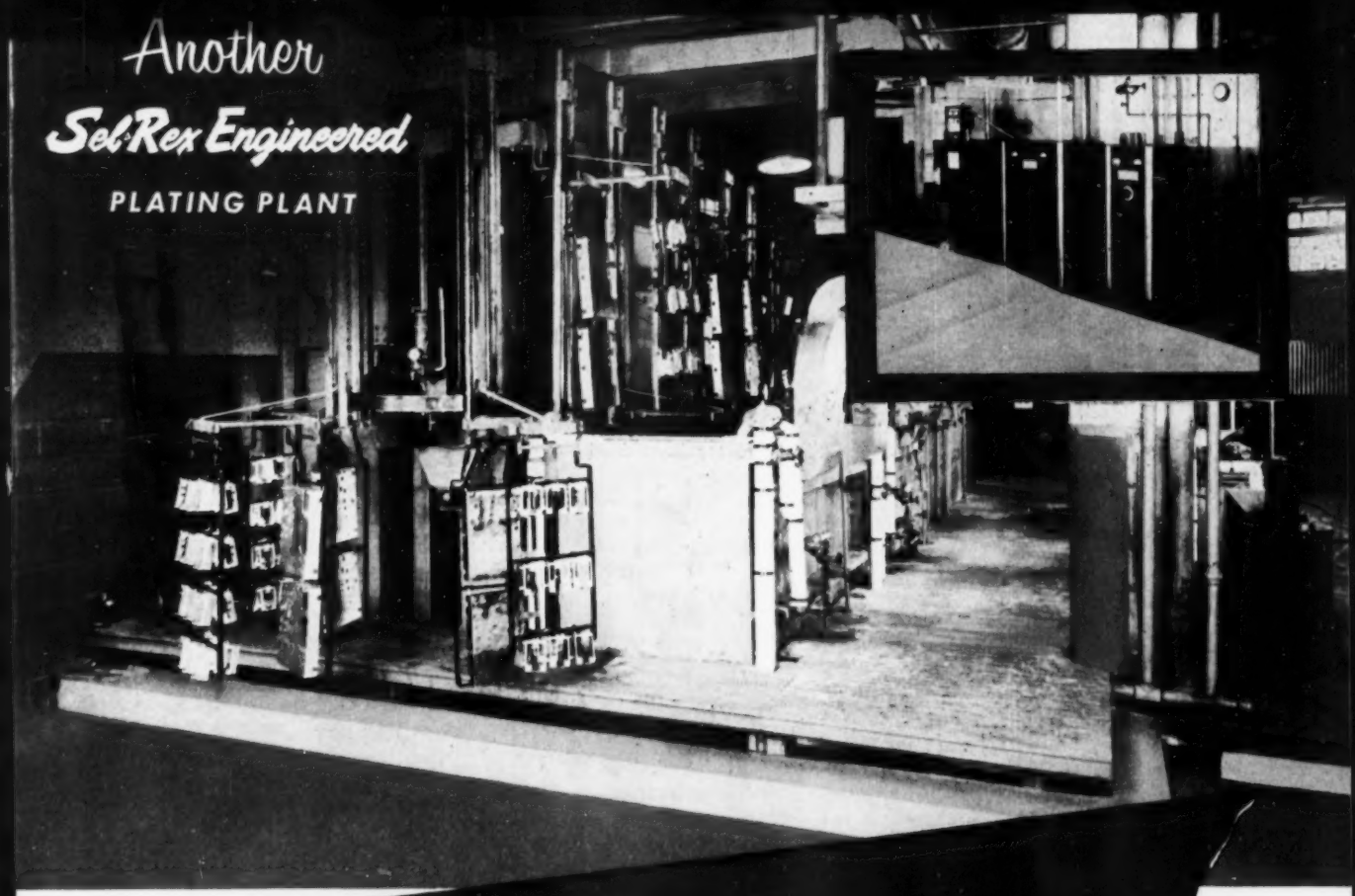
The advantages of McGean Bright Nickel are manifold . . . the stability and tolerance of the bath to impurities results in less frequent purification treatment . . . exceptional throwing power insures uniform deposits over irregularly shaped pieces . . . excellent deposits are obtained over various basis metals.

McGEAN

If you are not already a satisfied user of the McGean process, our laboratory can readily evaluate your present solution with respect to its conversion.

Ask our experienced plating specialists to discuss the application of The McGean Bright Nickel Plating Process to your particular operations.

The McGEAN Chemical Company
1040 Midland Building · Cleveland 15, Ohio



Another
Sel-Rex Engineered
PLATING PLANT

NEW! CBS-COLUMBIA FULLY AUTOMATIC PLANT FOR CADMIUM PLATING

"PUSH-BUTTON" PLANTS
Completely automatic plating, at the push of a button—a complete cycle from load to unload—designed and installed by Bart-Messing Corporation.

Add another great installation to the already huge list of Sel-Rex Engineered plating plants. One of the latest is the CBS-Columbia (the television and radio receiver manufacturing division of the Columbia Broadcasting System) "Push-Button" Cadmium plating plant, capable of plating 2500 television chassis, 1500 radio chassis and accessory parts in a normal working day using Sel-Rex Selenium Rectifiers to provide the dependable d.c. power to assure uninterrupted production.

If you are considering expansion or modernization of your plating plant, contact Bart-Messing Corporation. Only Bart-Messing Corporation offers a complete and modern service to the electro-plating industry that is backed by years of heavy industrial plating experience.

Sel-Rex

BART-MESSING CORPORATION

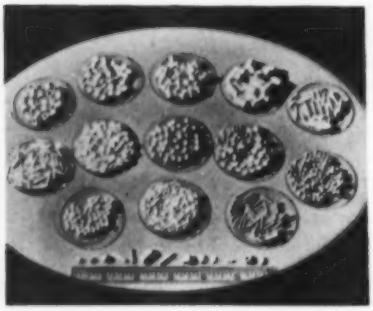
229 Main Street Dept. PL-8 Belleville 9, N. J.

NEMA

SEL-REX ENGINEERED PLANT LAYOUTS AND INSTALLATIONS ... PLATING EQUIPMENT AND SUPPLIES.

Equipment and Supplies

E—817. New Tumbling Media—The American Lava Corp., a subsidiary of Minnesota Mining & Mfg. Co., Chattanooga 5, Tenn., has released technical data on new tumbling media.



The new AlSiMag ceramic tumbling media have these advantages: (1) extremely hard and wear resistant; (2) chemically inert; (3) can be used wet or dry; (4) light in weight, specific gravity from 2.0 to 4.0, depending on composition; (5) there are many standard sizes and shapes of media. Custom made sizes and shapes available promptly at reasonable cost; (6) selection of the most favorable size, shape and weight of media can greatly improve quality, reduce tumbling time and cost.

Suggested uses: for polishing and burring light articles such as plastics, wood, light metals. Can be used also as milling or blending media in ball mills and as slurry carriers in wet tumbling. Samples of AlSiMag tumbling media will be sent on request, use Reader Service Card.

E—818. New Degreasing Solvent—Octagon Process, Inc., 15 Bank St., Staten Island 1, N. Y., has developed a new degreasing solvent, which will remove light oils from metal parts more cheaply than vapor degreasing. It is a low cost method which saves as much as 50 per cent of the cost of vapor degreasing, where trichlorethylene and perchlorethylene are used.

Klearall 95 is used cold, evaporates rapidly from parts, and can be redistilled dozens of times. It has no objectionable odor, is nonexplosive, does not support combustion, and does not contain carbon tetrachloride. For more information on the new solvent, use Reader Service Card.

E—819. Compact Belt-Polishing Unit—A belt polishing machine with contact wheel, idler wheel and drive motor all mounted on a single base now is being made by Stephen Bader & Co., Rockville Center, N. Y. Called the Bader Space Saver, this unique, single-based polisher not only occupies a minimum amount of space, but also simplifies installation, eliminates tracking problems and reduces the need for adjustments during operation. Its working area freedom permits the polishing of awkward and irregular work pieces. This new machine uses a standard 132-inch belt length with a variety of contact wheel sizes. Wheel diameters from 4 inches to 18 inches can be used on the machine without changing surface speeds or belt size. For more information on this equipment, use Reader Service Card.

E—820. Pipe Markers Stick to Pipes as Hot as 300° F—A new improvement in their line of self-sticking pipe markers, which makes them unaffected by extreme temperatures of the pipes to which they are applied, is announced by W. H. Brady Co., 727 W. Glendale Ave., Milwaukee 12, Wis.

Brady pipe markers will stick—and stay stuck—at continuous temperatures from -300° F to +300° F . . . intermittent temperatures to 450° F. These all-temperature markers stick without moistening to bare or insulated pipes. They replace slow, costly hand painting and stenciling . . . give positive identification for only a few cents per marker. They conform to ASA standard A-13, with the

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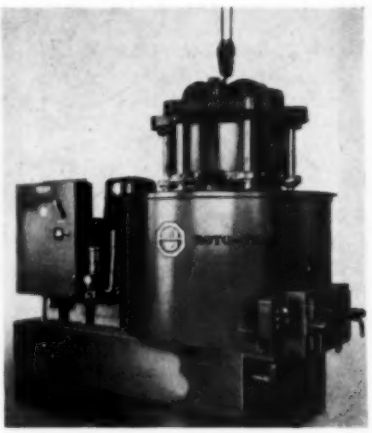
specific name of the material in the pipe printed in bold, black letters on the proper ASA-specified background color. For more information, use Reader Service Card.

E-821. New Aluminum Cleaner—The development of Acid Solvent Emulsion Cleaner No. 1, a new chemical for completely removing soil from fabricated aluminum parts prior to finishing, has been announced by Northwest Chemical Co. of Detroit.

The cleaner prepares the surface for any type of final finishing whether it be plating, painting, anodizing, zinc chromate priming or others. Easily rinsed, fast cleaning, and easily controlled this Solvent Emulsion Cleaner No. 1 is readily emulsifiable. It is economical to use since all that is necessary to control the mixture is the addition of water to replace evaporation and small cleaner additions to maintain efficiency. For more information on this product, use Reader Service Card.

E—822. Tank Warmup Time Reduced by Platecoils—Pipe coils originally were used in a Parker Bonderite system in the paint department of Burroughs Adding Machine Co., Detroit, Mich. In the first year after Platecoils supplied by Tranter Mfg., Inc., Lansing, Mich., were installed, company officials reported, "Replacing original pipe coils with Platecoils has resulted in reducing warmup time from 2 hours to ½ hour and has eliminated the problem of chipping scale from coils at least once a month." They report $1,440 a year was spent for cleaning pipe coils, but no maintenance expenditure was required in a year's time for Platecoils. In addition, Platecoils require only about 50 per cent as much space in the tank. The pictures provide a graphic before-and-after illustration. The original pipe coils, top picture, coated badly and the coating was difficult to remove. The Platecoil units show virtually no coating and have required no maintenance. For more information, use Reader Service Card.

E—823. Special Fixture Machines for Precision Metal Finishing—New engineering developments by the Roto-Finish Co., Kalamazoo, Mich., have extended the original barrel finishing process to



include entirely new special fixtures, machinery and equipment. The new machines are a departure from the generally accepted conception of the tumbling or barrel finishing process. For instance, in the new Roto-Tron, fixtured parts are oscillated through an abrasive media that remains relatively static. This machine is best suited for finishing parts which are too large to be handled by the conventional Roto-Finish cylinder type of machine. The Roto-Tron machine has proven very effective in finishing stampings, forgings and castings such as jet engine compressor and turbine blades, and flame deflectors. Also brass and steel stampings having close tolerances and requiring high finish, bezels, escutcheons, knobs, handles, etc. Fine finishes have been obtained also on zinc die castings such as door handles, ornaments, lamp parts, knobs, and mouldings at a very satisfactory production rate. For more information on these machines, use Reader Service Card.

E—824. Low-Cost Bench Model Tumbling Barrel—Lord Chemical Corp., York, Pa., announces the new Lorco Model 100 bench tumbling barrel. Built entirely of heavy gauge steel, the Lorco Model 100 occupies only 14 x 24 inches of bench space. The 7½ x 12 inches plastic lined, steel drum rotates on double shafts mounted on heavy channels carried by self-aligning ball bearings. A 6 x 7 inches

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The PERMAG line of cleaning compounds for the electrolytic cleaning process of the plating industry makes possible a solution for every cleaning problem.

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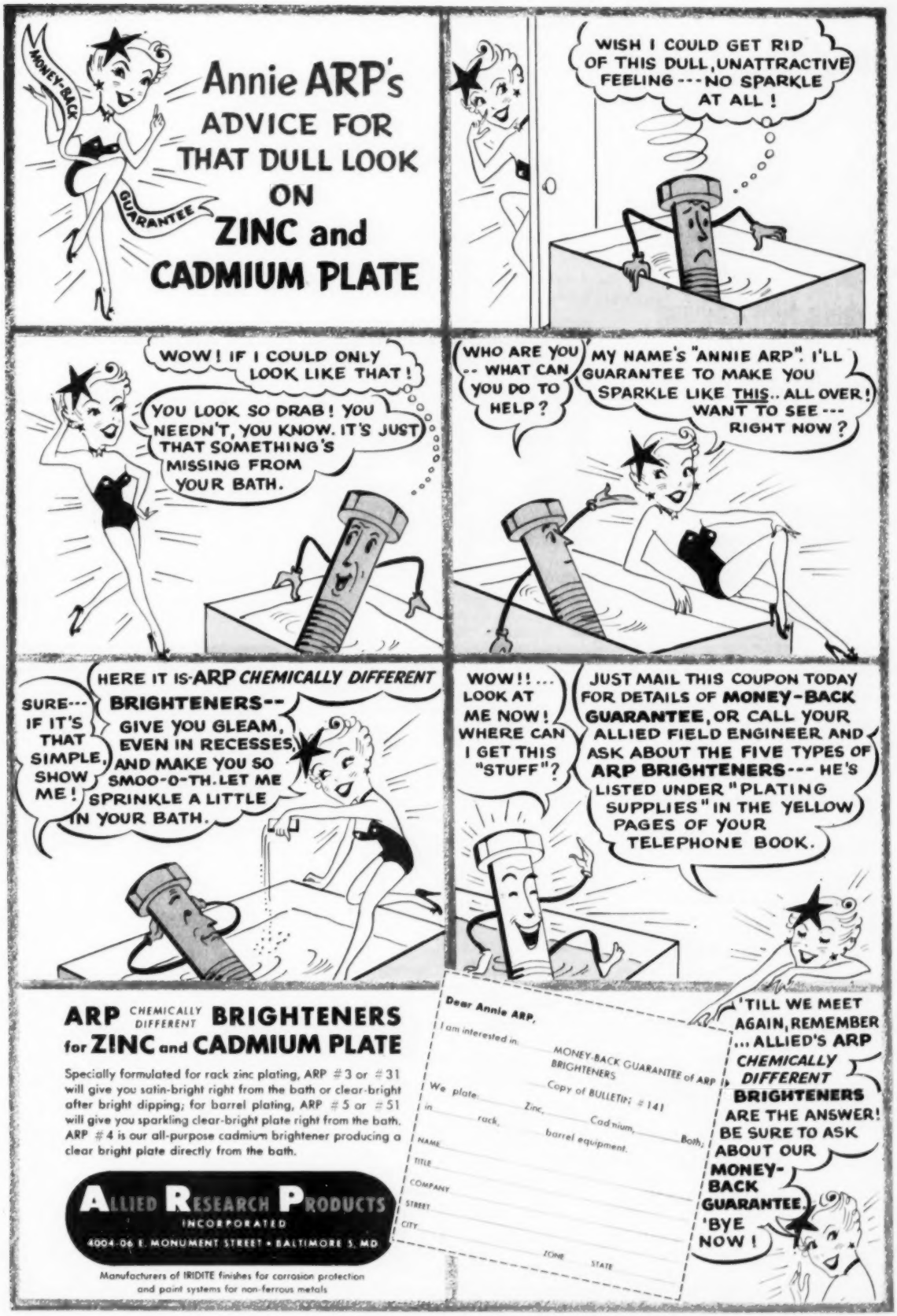
MONEY-BACK GUARANTEE
Annie ARP's ADVICE FOR THAT DULL LOOK ON ZINC and CADMIUM PLATE
WISH I COULD GET RID OF THIS DULL, UNATTRACTIVE FEELING --- NO SPARKLE AT ALL !
WOW! IF I COULD ONLY LOOK LIKE THAT !
YOU LOOK SO DRAB ! YOU NEEDN'T, YOU KNOW. IT'S JUST THAT SOMETHING'S MISSING FROM YOUR BATH.
WHO ARE YOU -- WHAT CAN YOU DO TO HELP ?
MY NAME'S "ANNIE ARP". I'LL GUARANTEE TO MAKE YOU SPARKLE LIKE THIS.. ALL OVER ! WANT TO SEE --- RIGHT NOW ?
SURE--- IF IT'S THAT SIMPLE, SHOW ME !
HERE IT IS-ARP CHEMICALLY DIFFERENT BRIGHTENERS-- GIVE YOU GLEAM, EVEN IN RECESSES, AND MAKE YOU SO SMOO-O-TH. LET ME SPRINKLE A LITTLE IN YOUR BATH.
WOW!! ... LOOK AT ME NOW ! WHERE CAN I GET THIS "STUFF"?
JUST MAIL THIS COUPON TODAY FOR DETAILS OF MONEY-BACK GUARANTEE, OR CALL YOUR ALLIED FIELD ENGINEER AND ASK ABOUT THE FIVE TYPES OF ARP BRIGHTENERS--- HE'S LISTED UNDER "PLATING SUPPLIES" IN THE YELLOW PAGES OF YOUR TELEPHONE BOOK.
'TILL WE MEET AGAIN, REMEMBER ... ALLIED'S ARP CHEMICALLY DIFFERENT BRIGHTENERS ARE THE ANSWER! BE SURE TO ASK ABOUT OUR MONEY-BACK GUARANTEE. 'BYE NOW !
ARP CHEMICALLY DIFFERENT BRIGHTENERS for ZINC and CADMIUM PLATE
Specially formulated for rack zinc plating, ARP #3 or #31 will give you satin-bright right from the bath or clear-bright after bright dipping; for barrel plating, ARP #5 or #51 will give you sparkling clear-bright plate right from the bath. ARP #4 is our all-purpose cadmium brightener producing a clear bright plate directly from the bath.
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Equipment and Supplies

steel door, 3/16 inch thick is neoprene lined. A sturdy perforated metal rinse door is included. For more information on this unit, use Reader Service Card.

E—825. Simple-Accurate Industrial Teskit—A simple teskit for controlling metal cleaning solutions that can be operated accurately by even untrained personnel has just been released by Wyandotte Chemicals Corp., technical service

department. By varying the testing solutions, the one basic Wyandotte teskit is adaptable to all industrial products in the Wyandotte line, except emulsion cleaners.

The new teskit makes it possible to keep solutions of alkaline soak cleaners, water wash spray booth compounds, electrocleaners, phosphating cleaners, rust removers, and metal etchants under instant control by a simple nontechnical testing procedure which any one can use accurately and quickly. For more information on this teskit, use Reader Service Card.

E—826. New Form of Potassium Cyanide—A new form of potassium cyanide now is being distributed by the Kaynide Division of Kraft Chemical Co., 919 W. 18th St., Chicago 8, Ill.

The new product, known as Cya-NODES, is cylindrical in shape about the size of a marshmallow, and weighs just one ounce. Cya-NODES, which are formed by cast process, are dust-free, sulfur-free, and nonflaking.

Costing no more than powdered cyanide, Cya-NODES are very high in purity (97.99 per cent minimum), dissolve very quickly, and are safer to handle. They are suitable for all electroplating processes. For more data on this product, use Reader Service Card.

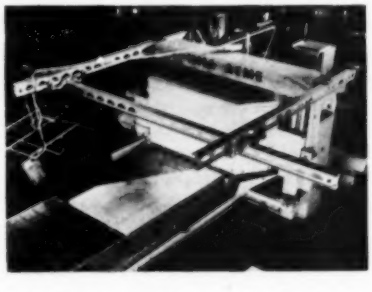
E—827. Centrifugal Pump Has Unique Features—Eco Engineering Co., 12 New York Ave., Newark 1, N. J., is offering a new small centrifugal pump made of Carpenter 20 stainless steel for handling a wide variety of corrosive chemicals or similar applications.

Maximum capacity is 30 gpm. It will pump against a head up to 24 pounds and has a maximum suction lift of 20 inches vacuum. For more data, use Reader Service Card.

E—828. Hook-On Volt-Ammeter—A new hook-on volt-ammeter believed to be the first with automatic scale changing has been announced by the General Electric Company's Meter and Instrument Dept., Schenectady 5, N. Y. Designated the AK-5, the pocket-size unit is designed to measure current and voltage quickly and accurately. Its automatic scale changing feature entirely eliminates the possibility of reading the wrong scale for the application, according to company engineers.

A valuable aid in balancing circuits, tracing faults and grounds, estimating distribution circuits, and diagnosing operating troubles, the volt-ammeter is an essential accessory for engineers, maintenance and service men, and others. For more data on this unit, use Reader Service Card.

E—829. World's Largest Precision Abrasive Belt Grinder—A revolutionary machining process using extremely wide endless factory coated abrasive cloth belts (138 inches long x 86 inches maximum



width) brings to the aircraft industry an entirely new and proven method of grinding flat and tapered aluminum aircraft wings and fuselage skins.

The Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio, has just completed the world's largest heavy duty abrasive belt grinding and polishing machine. This entirely new heavy duty design precision built abrasive belt grinder assures close tolerances on tapered sections and also produces a finish that is far superior to conventional taper rolling and milling operations.

The new taper skin grinding and polishing machine, equipped with a coarse grit silicon carbide abrasive belt, is equally efficient for heavy stock removal as well as grinding to close tolerances. Heavy grinding as well as the finishing operations are performed by using waterproof cloth abrasive belts together with a coolant. For more information on this equipment, use Reader Service Card.

avoid stream pollution due to chromium waste...

...with W&T Sulphur Dioxide Reduction Equipment

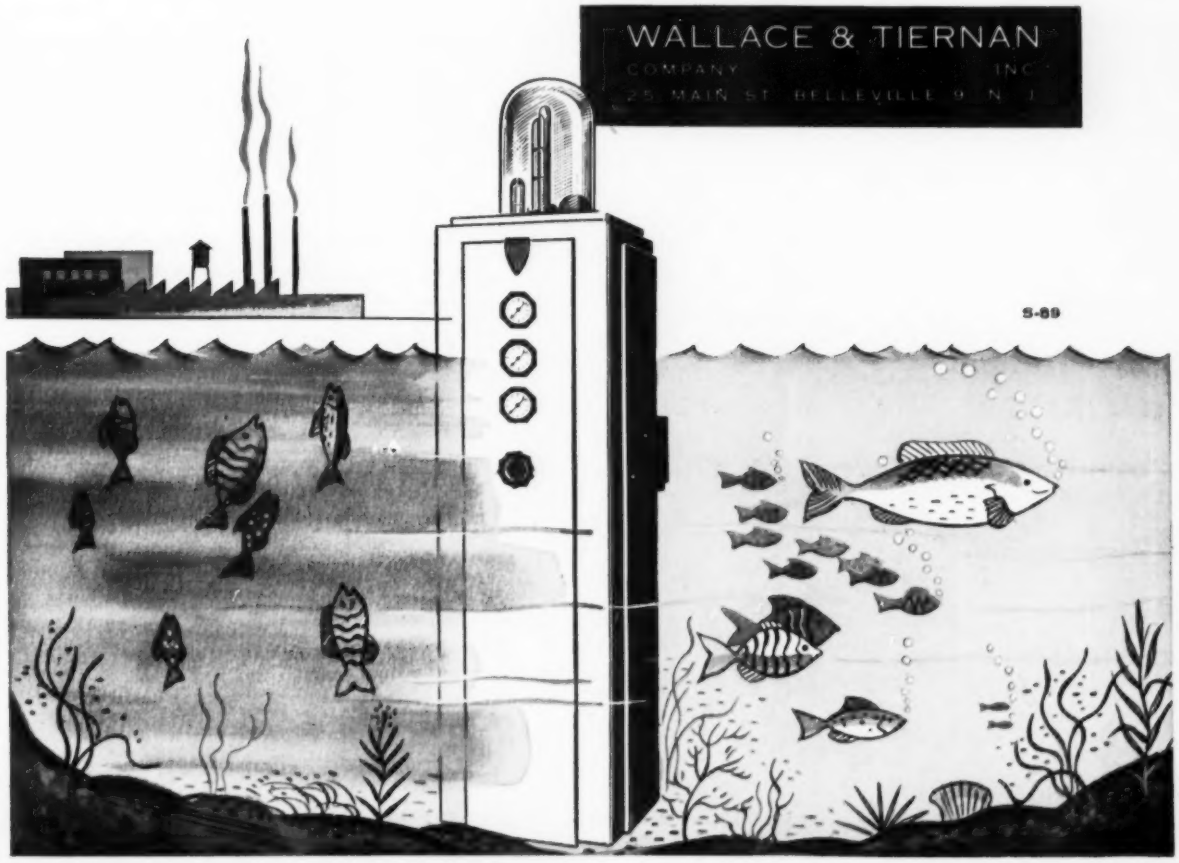
With the proper treatment equipment, toxic hexavalent chromium can be reduced by sulphur dioxide to the trivalent form and then completely precipitated by alkali for standard removal to a disposal area — such as a lagoon. After this treatment the waste water can be drawn off and safely disposed of in the usual manner. This treatment is in full compliance with most local and state pollution abatement laws.

Wallace & Tiernan offers the heat treating and metal finishing industries several types of Sulphur Dioxide Feeders with optional controls for manual, semi-automatic or fully automatic operation. These feeders are adaptable to either the "batch" or "flow-thru" methods of treatment in both large and small plants.

Similar equipment is also available for the destruction of cyanide waste by alkaline chlorination.

W&T offers PROVEN EQUIPMENT — hundreds of similar units are serving industry today, EXPERIENCE — over forty years of building chemical feeding equipment, and SERVICE — field representatives are located in principal cities throughout the country.

Write today for additional information on W&T Sulphur Dioxide Feeders and Alkaline Chlorination Equipment, at no obligation to you, of course.

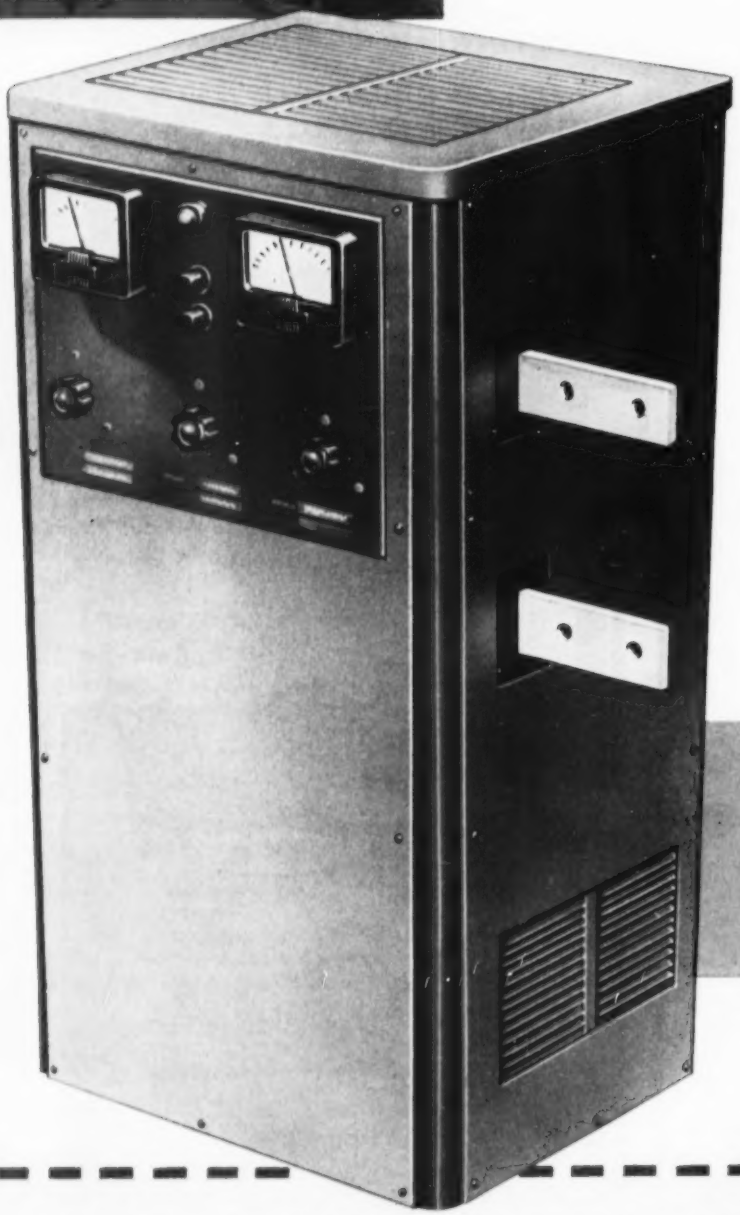


Many hands lighten the load... AND

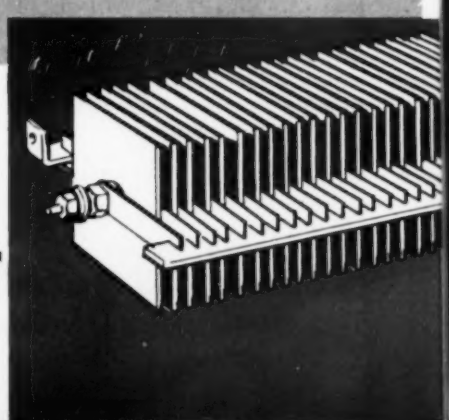
WAGNER RECTIFIERS' 40% INCREASED STACK AREA PREVENTS OVERLOAD

Electrical overloads and over-heating are avoided by ample rectifying stack area. The new Wagner Brothers selenium rectifiers offer you an unprecedented 5.4 square inches of rectifying surface per ampere. We've always rated conservatively, as the year-after-year performance of our previous models will testify. But this 40% increase sets new standards of operating efficiency and reduces your maintenance costs to a record low in electroplating history.

PEAK EFFICIENCY—Excess heating greatly decreases rectifier service life. This conservative Wagner stack design, more plates, greater surface, avoids high temperatures. And in addition, thermal overloads on magnetic contactors protect the equipment should a continued heavy overload occur. Our rugged transformers are especially built for our requirements, and insulated with the highest quality non-flammable insulating materials such as glass, mica and asbestos.

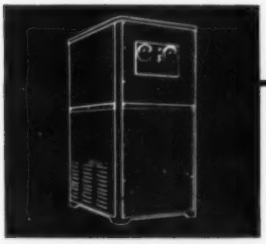


Advanced design and protection features increase service life, make your maintenance simply a periodic operation of oiling the fan and blowing dust from the unit. Installation is completely engineered, no fumbling.



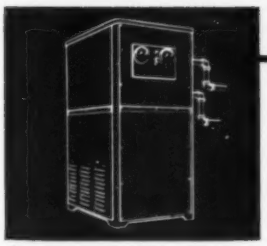
SIMPLE MAINTENANCE AND INSTALLATION

A WAGNER MODEL FOR YOUR SPECIFIC NEEDS



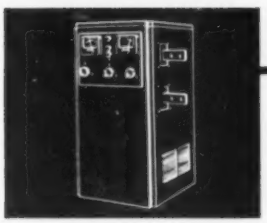
LARGE PACKAGE UNIT

Capacities from 2,000 to 50,000 amperes. Forced-air, fan-cooled type operates at all commonly used voltages. Requires only input and output connections for operation.



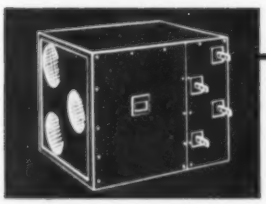
WATER COOLED

Capacities from 1,500 to 50,000 amperes. This unit consists of an air circulating system with a heat exchanger, uses your regular water supply (which can then be used for rinse tanks) as a heat removing medium. Functions well under very corrosive atmospheric conditions, or where extremely high ambient temperature is encountered.



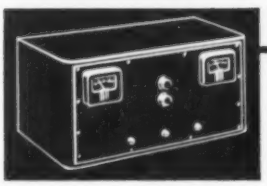
SMALL PACKAGE UNIT

Capacities from 250 to 2,000 amperes. Fan-cooled with exhaust from the top of the cabinet. Very compact to facilitate moving. Requires only three wires for input and output connections. Equipped with ammeter, voltmeter, shunt, starting equipment and regulation if required.



CUBICLE

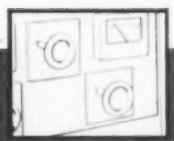
Capacity to 1,500 amperes. Designed for the building block type of operation, since the horizontal flow of cool air permits stacking. The addition or subtraction of total current output is easily accomplished.



BENCH TYPE

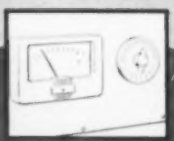
Capacities from 5 to 200 amperes. Special design affords extreme flexibility of operation and meets exacting requirements of control, ripple and accuracy ideally suited to laboratory research and development work.

REGULATORS AND CONTROLS

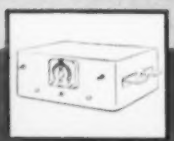


TAP SWITCH—Tapped auto-type transformer for phase selection makes changes under load without interruption.

POWERSTAT—Continuous control as voltage is changed. Toroid wound auto-type transformer.

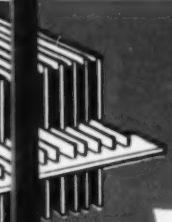


SATURABLE REACTOR MAGNETIC AMPLIFIER—Automatically stabilizes control of either voltage or current.



CURRENT REVERSAL UNITS—Standard units available in multiples of 250 amperes.

CURRENT INTERRUPTION UNITS—For use where periodic interruption of dc current is desirable.



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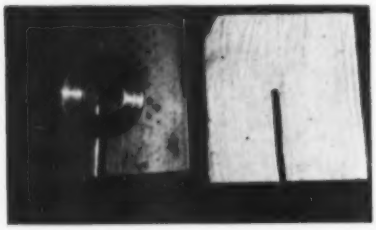
E—830. Tungsten-Hard-Surfacing Applied with a Paint Brush—An entirely new kind of "metal-cladding" which can be applied by anyone to any surface at room temperature, which not only imparts to the chosen substrata a hardness and abrasion resistance almost equal to



Both of the brass squares above were subjected to the same treatment (a hollow steel rod was rotated against them for 20 minutes at 1725 rpm under 75 pounds pressure). The one on the right was protected by a coating of Tungstide, and was not even marked; the one on the left was worn to a depth of nearly 1/16 inch

metallic tungsten, but is self-lubricating as well has been announced by The Lockrey Co., Southampton, N. Y., under the trade name of "Tungstide."

Metallic tungsten of near-colloidal particle size is suspended in a new type of extremely hard-liquid plastic, and incorporated in the mixture is a hardening form of the Company's "Liqui-Moly," providing a dry, clean built-in lubrication, with the well-known antiseize and antiscoring properties of molybdenum disulfide.

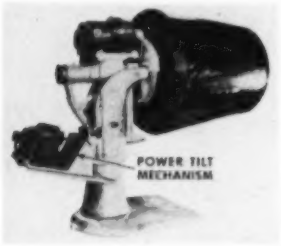
Tungstide is being tested now in applications where a "case-hardening" effect is desired on brass, plastics, and other softer materials. For more information on this product, use Reader Service Card.

E—831. New Electrocleaner for Brass and Copper—Oakite Products, Inc., 140 Rector St., New York 6, N. Y., have announced the development of Oakite Composition No. 191, a material for electrocleaning copper and its alloys prior to plating. The new cleaner is said to possess special ingredients that reduce tarnishing of work in the higher temperature cleaning ranges, or where long-treating cycles or prolonged transfer periods may occur.

Oakite 191, the manufacturers state, is a free-flowing, fast-dissolving granular product whose solutions are colorless and have little or no odor. Among the advantages claimed for this material are: (1) long solution life; (2) broad current-density range; (3) wide temperature range, 160° to 210° F; (4) cleans at low concentrations; (5) removes buffing dirt and other common soils rapidly; (6) excellent rinsability in both hot and cold water; (7) keeps tarnishing at a minimum.

For further data regarding this new material, use Reader Service Card.

E—832. Power Tilt for Direct Drive Barrels—Uniform tumbling angles, reduced operator fatigue, 20 per cent savings of floor space is achieved with Globe's line of direct-drive tumbling barrels with the development of power tilting, according to Hupp Corporation, 1250 W. 76th St., Cleveland 2, Ohio. Said to be extremely easy to operate, the tilting mechanism is controlled by a reversing drum-type switch. The unit is designed for manual starting, with automatic shutoff at adjustable high and low limits. Use of the power tilt with Globe direct-drive barrels eliminates the conventional handwheel. This, the manufacturer states, saves 3 square feet of floor space per machine.



The power tilt device is available optionally with Globe's direct-drive barrels at rated capacities of up to 3,000 pounds. For more information on this equipment, use Reader Service Card.

E—833. Cartridge Type Demineralizer—To answer the demand for a cartridge type demineralizer that will deliver pure demineralized water under pressure so that it can be piped to any desired point or employed in pilot plant operations, or used as feedwater to other devices, Barnstead Still & Sterilizer Co., 228 Lanesville Ter., Forest Hills, Boston 31, Mass., announces its new Model BD-2 pressure bantam demineralizer.

The Barnstead pressure bantam is a compact well-mounted demineralizer that connects directly into any water line as simply as a filter. It is a nonregenerative unit that does not require acid and caustic regenerant solutions but employs a replaceable resin cartridge. The unit delivers demineralized water in continuous flow under pressure from 5 to 25 gallons per hour. No heat or cooling water is required. For more data on this equipment, use Reader Service Card.

E—834. All-Purpose Flexible Abrasive Wheels—The Metal Removal Co., 1546 N. Orleans, Chicago 10, Ill., is introducing its new abrasive product, Flextex. This new line consists of mounted points, straight wheels, depressed center discs, and cutoff wheels.

Flextex is an all-purpose wheel for roughing and finishing practically any material in one operation. It is a blending of abrasive grains, synthetic fibers, and a specially developed binding agent. Being resilient and flexible, these abrasive products absorb shock, reduce chatter, and resist loading. For more information on this product, use Reader Service Card.

E—835. Buffing Compound Applicator—A new air-operated automatic buffing compound applicator that will accommodate bars up to ten inches wide (two inches thick) has been announced by the George L. Nankervis Co., 19255 W. Davison, Detroit 23, Mich. Designated the Model 610, it becomes the ninth model in a series of electric and air applicators accommodating round and rectangular compound bars.

The new applicator can be installed on all types of buffing machines from simple lathes to multioperation automatics. Lightweight construction permits installation on floating heads without disturbing balance. It can be installed in any position without affecting operation. An important feature of the new applitor is its ability to feed any number of strokes per minute . . . applying compound only when required. For more data on this equipment, use Reader Service Card.

E—836. New Degreaser Design—Coric Equipment Co., 120 Central Ave., Clark Township (Rahway), N. J., has announced a new degreaser design. Water condensation and resultant hydrolysis will no longer take place along the sides of the degreaser, causing them to rust. The water temperature regulator is placed after the water leaves the cooling coil and before it enters the water jacket. This permits accurate control of water in the coil, plus insuring the water entering the water jacket is between 90–120°. All pumping parts are fabricated of stainless steel. The rotor and end plates are nickel clad. For full details on other features of this new design, use Reader Service Card.

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A STUDY OF LEVELING IN CYANIDE COPPER BATHS*

BARNET D. OSTROW† AND FRED I. NOBEL†

Introduction

Because of the mounting labor costs encountered in polishing and prefinishing of plated parts, considerable interest has been aroused during the past few years in the leveling characteristics of plating baths. The ultimate aim of reducing or, possibly in some instances, of completely eliminating such polishing operations by plating means has become the goal of many production men and has served as an impetus to the laboratory and research worker.

Considerable work has been performed on leveling in nickel solutions. A number of excellent papers were presented at the 37th Annual Convention of the AES (1950) in the symposium on leveling. The present costs of nickel as well as its possibility of tight future supply may act as a deterrent to its use. Jernstedt[1] reported the use of periodic reverse plating with cyanide copper solutions to obtain leveling; however, no study or report has been made or published using direct current.

Du Rose[2] *et al* have presented an excellent review and theoretical and mathematical analysis of leveling. It is the writers' belief that the major contributing factor to leveling in plating solutions is caused by polarization differences between elevations and depressions. In Fig. 1 e_1 is used to designate the potential at the elevation of the scratch, e_2 the potential at the valley of the scratch and Δe the potential difference between e_1 and e_2. It is believed that two major factors enter into this mechanism, deposition potential of the metal plated and polarization at the cathode caused by the addition agents. Based on this assumption, it will be explained in detail with examples, after the presentation of data on cyanide and acid copper, how these factors influence such leveling and why it is comparatively simple to secure leveling from an acid copper bath and not from a cyanide one. It should not be overlooked that other factors may enter into the leveling phenomenon such as hydrogen evolution, hydrogen or addition agent absorption, stress in the deposit and stress concentration in the area about the scratch. It is believed, however, that the greatest contributing factor is the aforementioned relationship between polarization and deposition potentials of the metal being plated.

It was also of considerable interest to the writers that the tendency for leveling was much greater in an acid copper bath than in a cyanide bath. This interest was further awakened when private communications[3,4] called attention to the fact that a proprietary bright cyanide copper‡ bath used for plating zinc die castings at times with an improper balance of addition agents reproduced all buff marks present on the original metal and at other times with a proper balance of addition agents completely "hid" such buff marks and tiny scratches.

This ability to hide buff marks and small scratches was tabbed by the production and lab men as "hiding power" of the bath. Interestingly enough this "hiding power" was and could be determined with the naked eye, and was not measured by any instrument. It was believed that the "hiding power" secured from such a bright cyanide copper bath was some form of leveling. It was decided to make a study to determine whether this "hiding power" was a form of leveling, and what conditions favored or did not favor leveling.

Preliminary Study

In order to determine whether "hiding power" was

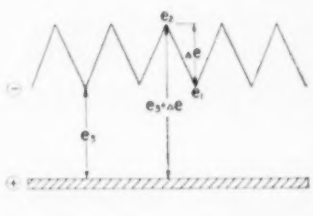


Fig. 1. Potential difference between anode and base and surface of a scratch on the cathode

*Presented at the Forty-first Annual Convention of the American Electroplaters' Society, July 12, 1954.
†Lea-Ronal, Inc., Long Island City, N. Y.
‡Lea-Ronal Bright Cyanide Copper Process.

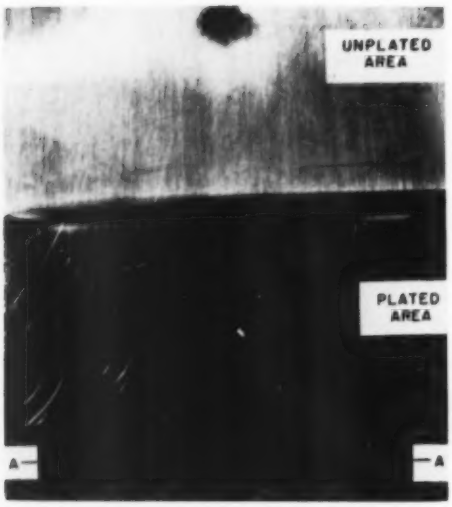
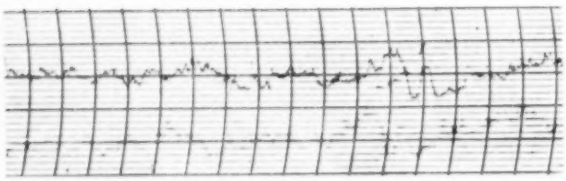
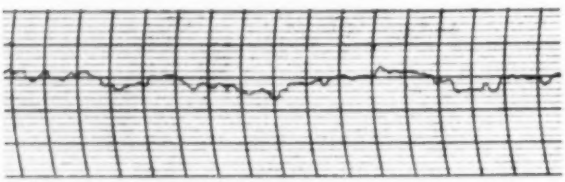


Fig. 2. Obliteration of buffing lines by a bright cyanide copper. Thickness, 0.001 inch

a measurable quantity that could be evaluated by a surface analyzer, brass or copper panels 4 x 3 inches were prepared by buffing to a high luster, but still leaving visible buff marks on the surface. The lower half of the panel was plated with 0.001 inch of copper in a proprietary* bright high efficiency type of cyanide bath at 160° F and 40 asf. On examination the plated half appeared to have "hidden" the buff marks, whereas on the unplated half, the buff marks were still visible—in fact a definite line of demarcation occurred with the buff lines stopping short and completely disappearing on the plated area with the plated area appearing brighter (Fig. 2). Initial evaluation of this panel was performed on a specially damped surface analyzer[4] and showed some interesting results (Fig. 3). It should be noted that, although the magnitude of the roughness for the plated and unplated panels remained essentially the same, the high-frequency micro-roughness practically disappeared on the plated panel. It is this high frequency reduction that gives the plated panel a brighter or truer surface. It is therefore especially interesting to note that other factors besides reduction in RMS may enter into leveling. In this case, although the RMS value of the surface remained essentially the same, the frequency of the roughness was reduced with a resultant change in the reflectivity of the panel.



RMS before plating: frequency factor 72, RMS range 0.7–1.0



RMS after plating: frequency factor 24, RMS range 0.7–1.0
Reduction in RMS 0, reduction in frequency 48

Fig. 3. Brush analyzer traces of panel shown in Fig. 2 showing the effect of 0.001" of a proprietary bright copper on RMS and frequency of roughness values

Experimental

In this and the subsequent paper on "A Study of Leveling in Acid Copper Baths," leveling is measured by the use of a Brush Surface Analyzer using a direct-inking oscillograph to record the readings. The instrument has been described fully by Kellner.[5] In all cases where RMS values averaged over 10 μin the attenuator was set at 0.01 in order to make each small division equal 10 μin. For lower RMS values, the gain control knob was raised to double the readings making each small division equal to 5 μin. By doing this, the sensitivity was doubled for the lower readings.

It must be remembered when evaluating the graphs produced by the oscillograph that these are really distorted charts and do not actually represent the true cross-section of the surface. The magnification of height of the undulations is always considerably greater than the width, giving a chart that is compressed lengthwise to a size that the eye can evaluate. Otherwise, the oscillograph would produce charts that are perhaps 10 feet long to show only 1/64 inch of surface. In viewing the charts one must always remember this distortion and therefore keep from considering the various hills and valleys as though the trace were actually a true representation of the surface.

The RMS meter is that part of the Brush Surface Analyzer which averages the RMS of the surface every 0.030 inch of stylus travel. Since the RMS values may vary considerably over the surface, the meter needle will fluctuate during the entire measurement. In order to evaluate the surface and arrive at an average RMS reading, the method of Weisberg[6] was used:

1. Five separate measurements were made, each at a different location.
2. For each measurement, the highest reading and lowest reading of the RMS meter was recorded.
3. Then the high readings and low readings were averaged separately, and the average of these two

*Lea-Ronal Bright Cyanide Copper.

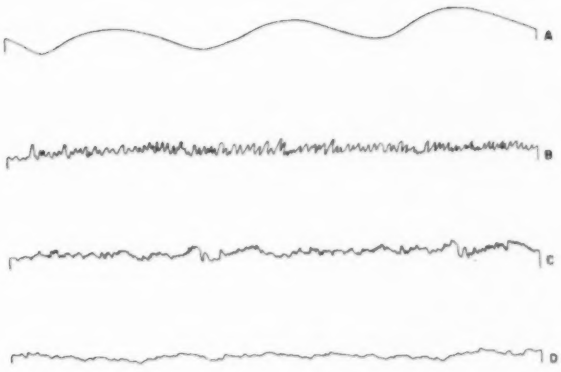


Fig. 4. Schematic diagram typical surface imperfections

figures was called the average RMS of the surface.

The values for RMS and frequencies are presented only as numbers used to evaluate the leveling effects of certain plating solutions and certain variables. The same specimens can give different readings on different analyzers and by different operators. To balance out such errors, the same instrument was used at the same location and always by the same operator.

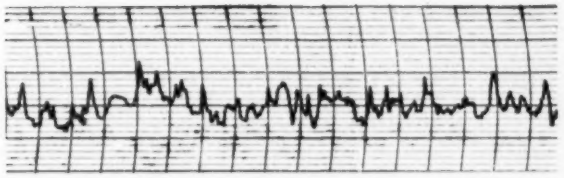
The frequency values presented were obtained by counting the number of moves made by the stylus for one inch of chart length. The value used was the average for three different areas on the panel.

Evaluation of the Surface

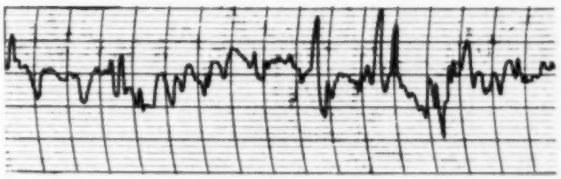
In production, a surface to be plated generally presents a conglomeration of imperfections. Fig. 4 shows a diagram of such a typical surface.

The large irregularities as shown schematically in Fig. 4A may be representative of "orange peel." The smaller irregularities as shown in Fig. 4B may be representative of scratches such as are produced by abrasives, by a polishing wheel or belt sander. In addition to these, there are very fine scratches which are too minute to be properly revealed by the stylus on a Brush Surface Analyzer. The presence of these minute scratches should not be overlooked since they tend to scatter light and so affect the overall appearance. It should also be noted that two surfaces having the same average roughness may still differ greatly in reflectivity due to the difference in the frequency of the roughness. This is indicated schematically in Fig. 4 (C and D), and has also been shown in Figs. 2 and 3.

While all these factors need to be considered in the evaluation of the surface, it is not possible to measure all of them properly with the apparatus available. Special attention is given to the frequency of the fine scratches since, as has been shown in Figs. 2 and 3, it is possible for a solution to exhibit leveling merely by a reduction in frequency even though the average RMS is not reduced.



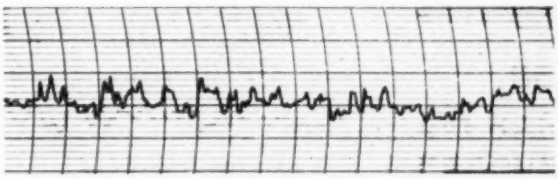
Before plating: average RMS 6, frequency factor 78, RMS range 3–8.5



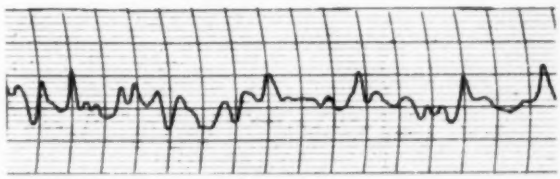
After plating: average RMS 9.5, frequency factor 60, RMS range 5–12

Reduction in RMS –3.5, reduction in frequency 17

0.0 oz/gal KCN



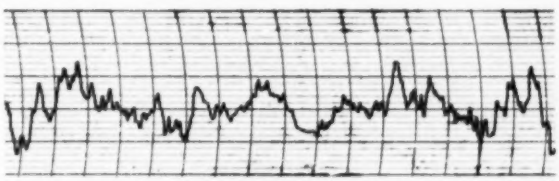
Before plating: average RMS 7.5, frequency factor 64, RMS range 5–10



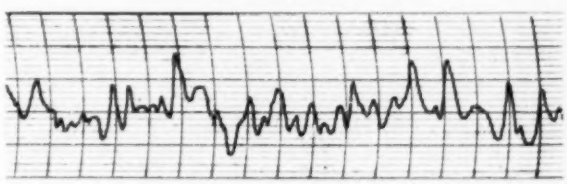
After plating: average RMS 11.5, frequency factor 17, RMS range 6–15

Reduction in RMS –4, reduction in frequency 47

1.25 oz/gal free KCN



Before plating: average RMS 8.5, frequency factor 78, RMS range 4–13



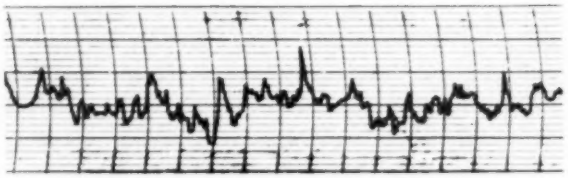
After plating: average RMS 11.8, frequency factor 62, RMS range 7–16

Reduction in RMS –3, reduction in frequency 16

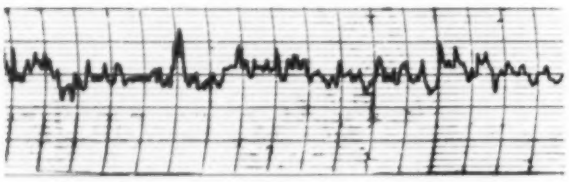
3.50 oz/gal free KCN

Fig. 5. Effect of free cyanide on leveling in the standard cyanide copper solution at 30 asf and with agitation

Before plating: average RMS 5.7, frequency factor 74.5, RMS range 3–10.5



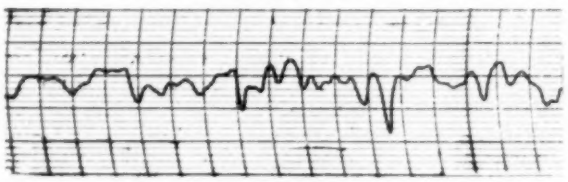
Before plating: average RMS 7.5, frequency factor 64.5, RMS range 5–10



After plating: average RMS 3.0, frequency factor 63.0, RMS range 2–4.5

Reduction in RMS 2.7, reduction in frequency 11.5

5 asf



After plating: average RMS 11.5, frequency factor 17, RMS range 6–15

Reduction in RMS –4, reduction in frequency 47.5

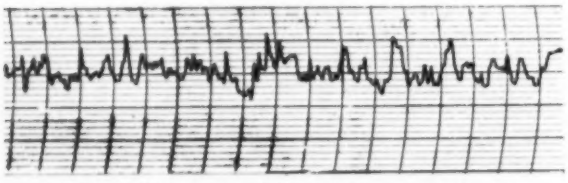
30 asf

Fig. 6. Effect of current density on leveling. Free KCN, 1.25 oz/gal

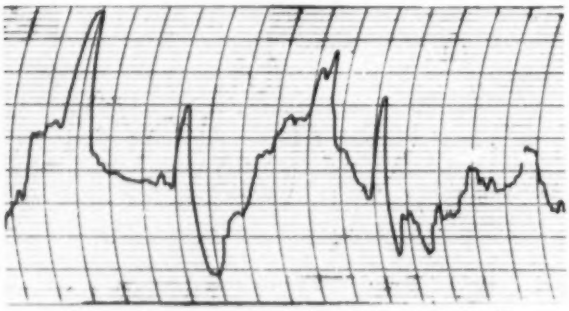
The term "surface truth" described by Gardam[7] may well be an average of all of the above-mentioned imperfections. A surface that has been leveled by plating will better reproduce an image than one that is not. It is a "truer" surface.

Preparation of Specimens

Copper panels 3 x 4 inches were prepared by using a belt sander on a back-stand idler. For specimens of high RMS, a 220 grit was used. Specimens of low RMS were produced by using a 320 grit followed by Len Grade C Compound. With these methods, even though the RMS varied somewhat from panel to panel, the frequencies were unusually alike.



Before plating: average RMS 8.4, frequency factor 64, RMS range 6.5–11,



After plating: average RMS 17.5, frequency factor 53, RMS range 5–32.5, no agitation

Reduction in RMS –9, reduction in frequency 11

Fig. 7. Effect of agitation on leveling. Free KCN, 1.25 oz/gal.

One thousandth of copper was deposited in all cases after which the RMS was determined in the same area for each panel in order to take into account differences in current densities that occur throughout the panel. This area was in a straight line across the bottom 3/4 inch from the bottom edge, as designated by line a-a in Fig. 2. In each case, the current density given is simply the average current density.

In addition to RMS measurements and frequency determinations, each panel was observed for brightness, bent to determine hardness and ductility of deposit and the plating characteristics of the solution were observed. The bend test for hardness was rather crude but it served as a relative measure of the degree of ductility.

All solutions used were prepared from commercial grade chemicals, were carbon treated and dummied in the accepted manner.

The basic solution under study was an all potassium one containing:

CuCN	8 oz/gal
KOH	2 oz/gal
Free KCN	Variable

Unless stated otherwise operating temperatures were 160° F, and agitation was equivalent to 12–15 ft/min. Initial tests conducted showed that under most conditions these copper cyanide solutions showed negative leveling, i. e., an increased roughness after electroplating, and this roughening effect was influenced to a great degree by the magnitude of initial surface roughness before plating. It was also determined that with high initial RMS, for example 40 μin, a greater degree of negative leveling occurred than with a surface of 20 μin. Whereas a surface whose RMS before

plating was below 10 μin exhibited either a small amount of negative leveling or a small amount of positive leveling.

Since these tests indicated that positive leveling could be obtained on surfaces whose RMS value before plating was below 10 μin it was decided to conduct this study using low RMS panels.

It was hoped that indications would be obtained as to what factors contribute to leveling in order to select conditions to greatly increase leveling.

Effect of Free KCN

Using the basic solution described above, panels were plated with a free KCN of 0, 1.25, and 3.5 oz/gal at a temperature of 160° F at 30 asf using solution agitation. Traces in Fig. 5 showed that there was negative leveling in each case as shown by the almost equal rise in RMS of −3 to −4 μin. Although there was an equal negative rise in the RMS value:

1. The frequency factor varied greatly with variation in free KCN.
2. The change in frequency factor was greatest at 1¼ oz/gal.
3. It was least with high free KCN.

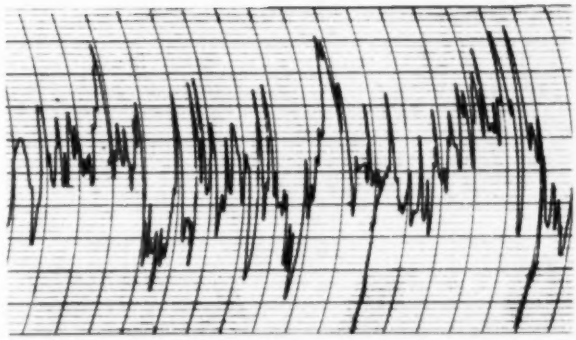
Effect of Current Density

Effects of current density on leveling in cyanide copper solutions were studied by plating a panel in the previously described manner at 5 asf and 30 asf, keeping all other conditions of temperature, agitation constant and maintaining a KCN concentration of 1.25 oz/gal. Fig. 6 shows that the RMS change was positive (2.7 μin) at 5 asf, whereas the RMS change at 30 asf was negative (−4 μin). However, the panel plated at 30 asf was far brighter than the one plated at 5 asf, even though the higher current density produced roughening of the deposit. It is interesting to note, however, the change in frequency of 47.5 for the 30 asf panel against the changes in frequency of only 11.5 of the 5 asf panel.

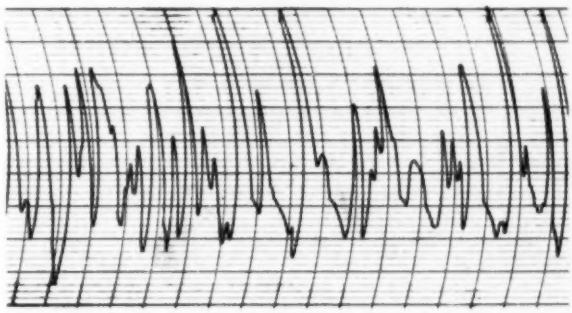
The unusual condition wherein the RMS change is positive and the frequency change is small on one hand and on the other hand the RMS change is negative but the frequency change is large results in a *brighter* panel in the case of the *negative RMS* than for the one with a positive value. An interesting question arises in this case as to which surface is leveled better. This introduces the possibility that Gardam's[7] concept of "surface truth" may have greater value as a means for the evaluation of a surface finish.

Effect of Agitation

A panel was plated as previously described in the standard type solution at 10 asf with no agitation. This current density was chosen because the deposits tended to burn at higher current densities. Fig. 7 shows that the change in RMS becomes more negative (i.e., the surface had become rougher) and that the change in frequency showed little improvement. Agitation may therefore be desirable for leveling in cyanide copper baths.



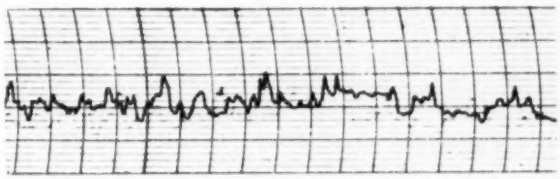
Before plating: average RMS 3, frequency factor 81.5, RMS range 1.5–4



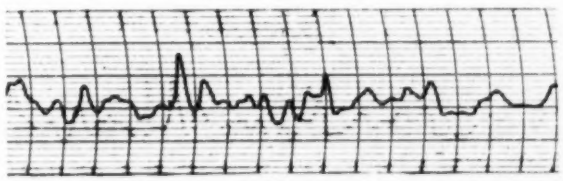
After plating: average RMS 3.5, frequency factor −47., RMS range 1.5–5

Reduction in RMS −0.5, reduction in frequency 34.5

No carbonate



Before plating: average RMS 7.5, frequency factor 64.5, RMS range 5–10.5



After plating: average RMS 11.5, frequency factor 17, RMS range 6–15

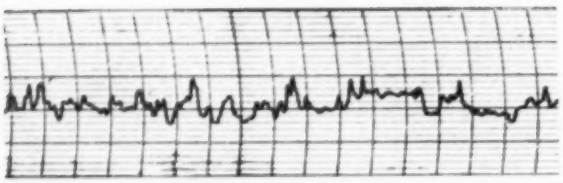
Reduction in RMS −4, reduction in frequency 47.5

8.0 oz/gal K_2CO_3

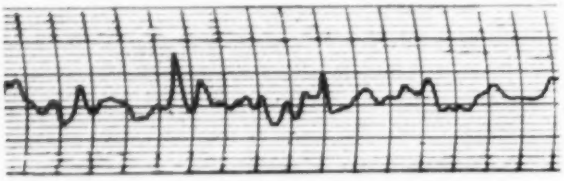
Fig. 8. Effect of carbonate on leveling

Effect of Carbonates

Carbonates are known to build-up in a cyanide copper solution due to decomposition of the cyanide and some absorption of the CO_2 in the air. To simulate an old production type cyanide copper bath, 8 oz/gal



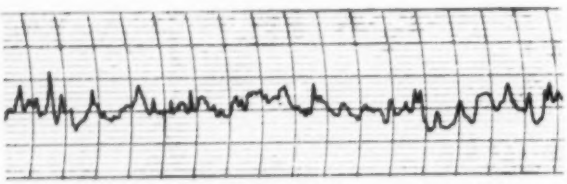
Before plating: average RMS 7.5, frequency factor 64, RMS range 5–10.5



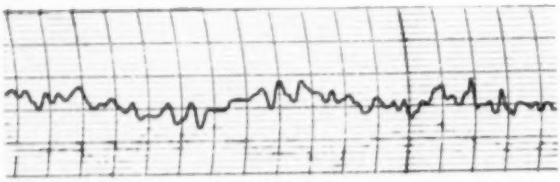
After plating: average RMS 11.5, frequency factor 17, RMS range 6–15

Reduction in RMS –4, reduction in frequency 47.5

No tartrate



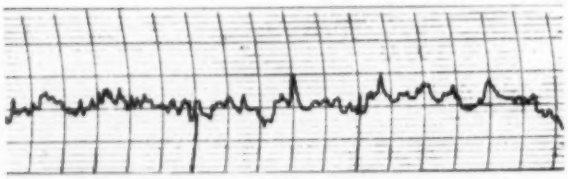
Before plating: average RMS 5, frequency factor 52.5, RMS range 3–8



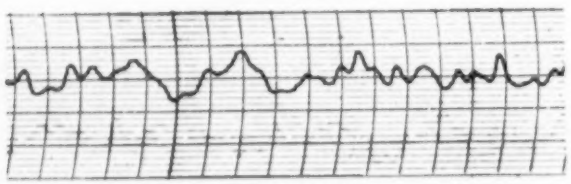
After plating: average RMS 6, frequency factor 29, RMS range 3.5–9

Reduction in RMS –1, reduction in frequency 23.5

Rochelle Salt, 6 oz/gal



Before plating: average RMS 4.5, frequency factor 56.5, RMS range 3–7.5



After plating: average RMS 4, frequency factor 20, RMS range 1.5–6.5

Reduction in RMS .5, reduction in frequency 36.5

Supertartral, 4 per cent by volume

***Fig. 9.** Effect of tartrates on leveling. Free KCN, 1.25 oz/gal; current density, 30 asf*

of K_2CO_3 was added to the basic bath, containing 1.25 oz/gal free KCN, and a panel plated as previously described. Fig. 8 compares the results obtained from a standard bath at similar conditions without carbonates to one containing carbonates. Since the initial starting panel used in the tests for the bath containing carbonates was of a very low RMS, it was quite difficult to secure a good trace. For these readings only, the attenuator knob on the instrument was set to multiply the magnitude of the readings by 10 so that each scale division equaled 1 μin to compare the effect before and after plating on this relatively smooth surface. With this concentration of carbonates in the solution the RMS change was negative at 0.5 μin and the frequency factor change was high. It therefore appears that carbonates are not detrimental to leveling and possibly under certain conditions may be beneficial.

Effect of Tartrates and Similar Materials

Tartrates have been used for many years in cyanide copper plating especially as an aid in anode corrosion. To test the effect of tartrates on leveling, 6 oz/gal Rochelle Salt was added to the standard formulation with the optimum free KCN of 1.25 oz/gal. Comparisons were made with panels plated under similar conditions but from solutions without tartrates. Similar tests were also conducted on a proprietary substitute for tartrates sold under the trade name of Supertartral* in the concentration of 4 per cent by volume.

Fig. 9 shows that the effect of tartrates as far as leveling is concerned is quite doubtful. Although Rochelle Salt may exert a very small reduction in RMS the reduction of the frequency of the roughness is only one-half as much as that without tartrates.

On the other hand, the proprietary material Supertartral appeared to exert a slight leveling action and at the same time did not adversely affect the reduction frequency as did the Rochelle Salt.

Proprietary Cyanide Copper Solutions

Since a large amount of present commercial high speed copper plating is performed from proprietary solutions it was decided to investigate these. Two such baths were investigated and are known commercially as Du Pont High Speed Copper and Lea-Ronal Bright High Speed Copper Processes.

The Du Pont Bath—The Du Pont bath was prepared in accordance with the formula recommended by the manufacturer and as described in Modern Electroplatplating.[8] Tests were conducted at 30 asf, at a free KCN of 1.25 oz/gal and a temperature of 170° F.

Fig. 10 shows that this solution gives some positive leveling with an RMS improvement of 2.5 μin and a frequency change improvement of 18 units. These deposits were uniform semi-bright and showed a definite improvement over the standard cyanide copper without addition agents.

*Trade mark Lea-Ronal, Inc.

Lea-Ronal Bright Copper—Tests were performed on a standard type solution recommended by the manufacturer of the process. This bath was the same as the basic formula tested, having proprietary addition agents and using Supertartral, a proprietary substitute for tartrates. Results here indicated that the leveling characteristics were similar to the Du Pont bath; the RMS improvement being 2 μin and the frequency improvement 17 units. The deposits were uniformly full-bright.

Other Addition Agents

All of the above solutions produced very definite negative leveling or roughening of the deposit when plating on surfaces that were initially very rough (RMS values 20–40 μin). This was true even though some solutions produced positive leveling when plating on low RMS surfaces.

To show that the prime contributing factor to positive leveling was due to increasing the potential difference between hills and valleys by polarization, many such known materials as alginates, starches, silicates, gums, and high molecular weight sulfur compounds were studied with negative results. In addition, some metal addition agents; namely tin, nickel, tungsten and molybdenum as the soluble salts were also tried with negative results.

Conclusion

This portion of the paper on cyanide copper was presented with the hope of serving as an impetus for further study of leveling in cyanide copper solutions using direct current only. It has been shown that under certain conditions some degree of surface smoothening may occur.

Acknowledgment

The authors wish to express their thanks and appreciation to Messrs. Neil Maffie and Frank Corso of Brown-Lipe-Chapin Division, General Motors Corporation, for introducing them to the phenomenon of "hiding power". Thanks is also due to Messrs. W. Tucker and F. O. Beuckman of Eastman Kodak Co., for their initial evaluation of a leveled panel using a special vibration damped surface analyzer and to Dr. L. Weisberg for his many helpful suggestions for presentation of data.

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[1]George W. Jernstedt, Proc. Am. Electroplaters' Soc. **37**, 151 (1950).

[2]A. H. Du Rose, W. P. Karash and K. S. Willson, Proc. Am. Electroplaters' Soc. **37**, 193 (1950).

[3]Private Communication, Neil Maffie and Frank Corso, Brown-Lipe-Chapin Division, General Motors Corp., Syracuse, N. Y.

[4]Private Communication, W. Tucker and F. Beuckman, Eastman Kodak Co., Rochester, N. Y.

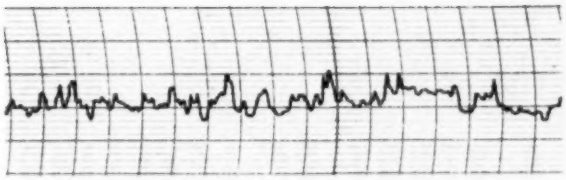
[5]H. L. Kellner, Proc. Am. Electroplaters' Soc. **37**, 105–122 (1950).

[6]L. Weisberg, Proc. Am. Electroplaters' Soc. **37**, 123 (1950).

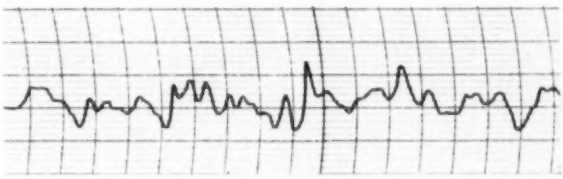
[7]G. E. Gardam, J. Electrodepositors' Tech. Soc. **26**, Advance Copy 4 (1950).

[8]"Modern Electroplating," John Wiley & Sons, p. 216 (1953).

Discussion of paper appears on page 899



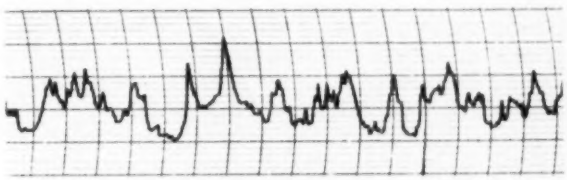
Before plating: average RMS 7.5, frequency factor 64.5, RMS range 5–10.5



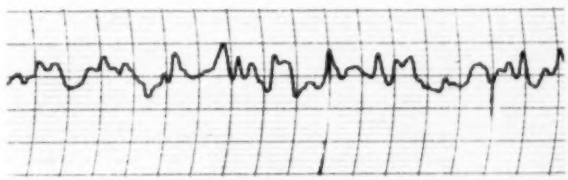
After plating: average RMS 11.5, frequency factor 17, RMS range 6–15

Reduction in RMS –4, reduction in frequency 47.5

No addition agent



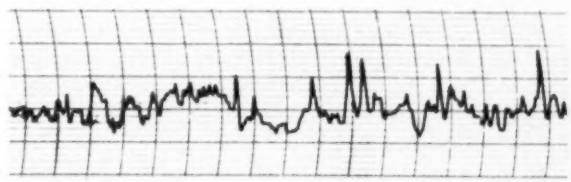
Before plating: average RMS 9, frequency factor 54.5, RMS range 6–13



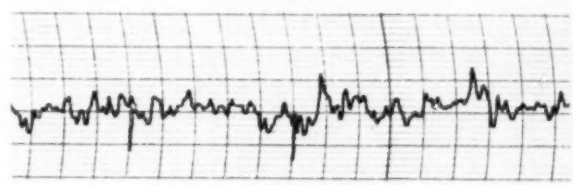
After plating: average RMS 6.5, frequency factor 36.5, RMS range 5–9.5

Reduction in RMS –2.5, reduction in frequency 18

Du Pont high speed K process



Before plating: average RMS 7, frequency factor 56, RMS range 5–11



After plating: average RMS 5, frequency factor 39, RMS range 3.5–7

Reduction in RMS 2, reduction in frequency 17

Lea-Ronal process

Fig. 10. Effect of addition agents on leveling in the cyanide copper solution. Free KCN, 1.25 oz/gal; current density, 30 asf

A STUDY OF LEVELING IN ACID COPPER BATHS*

FRED I. NOBEL† AND BARNET D. OSTROW†

Introduction

In addition to their application in electrotyping and electroforming, acid copper solutions have been used extensively for plating on unfinished or partially finished steel surfaces as a base for buffing. Copper deposits from these solutions are generally smooth, buffable, and show some degree of leveling.

It has been stated that great impetus would be given to the use of acid copper solutions if they could be made to plate bright and with the high leveling characteristics of present day semibright leveling nickel solutions. With an acid copper possessing leveling properties it would be possible to reduce the number of polishing operations necessary to finish rough steel surfaces. On some steels, it might be possible to obtain sufficient leveling to eliminate polishing completely. With the proper brightness from the acid copper, bright nickel could be plated directly on the copper without any intermediate buffing. Considerable savings in both plating and polishing costs would be realized if an acid copper solution could accomplish such leveling and brightness.

With the cost of nickel today almost three times that of copper, considerable savings in metal costs could be achieved by using copper in place of nickel for leveling. Furthermore, nickel is in short supply today and copper is readily available.

In the previous paper it was shown that cyanide copper solutions could not produce any appreciable amounts of leveling when using direct current, and the leveling was negative if the initial surface was very rough. It will be shown that acid copper solutions, however, can be made to exhibit a large degree of leveling regardless of the degree of roughness of the initial surface merely by adding certain addition agents. A working theory is presented at the conclusion of this paper which attempts to explain why acid copper solutions respond readily to addition agents as opposed to cyanide copper solutions.

A study was made of acid copper solutions to evaluate the factors and addition agents that produce leveling. The same instrument and methods were used as were described in the previous paper. The panels used for tests were all relatively rough surfaces of RMS values between 20 and 40 μin (0.5 to 1 μ). Agitation was provided by filtered air bubbling through the solution. Purified solutions were used at all times, and the anodes were bagged.

Acid Copper Solutions

The solution used for test was one commonly used in the industry and had the following formula (hereafter referred to as standard solution):

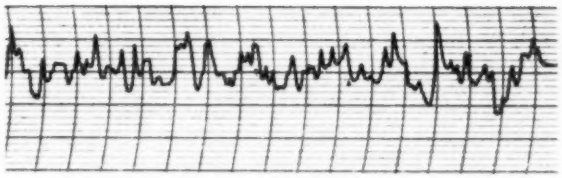
Copper sulfate	28 oz/gal
Sulfuric acid	7 oz/gal

Using vigorous air agitation and plating at 95° F and 25 asf, this solution produced a deposit that was dull but smooth and very soft. The average RMS value was decreased by 1½ μin and the frequency factor was decreased by 11 units showing a slight amount of leveling under these conditions.

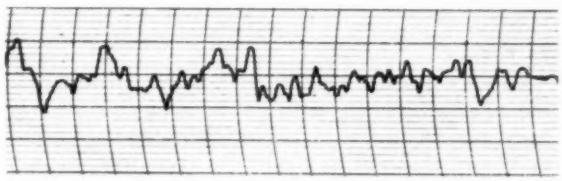
The same solution plating at 50 asf produced a very dull, grainy deposit, slightly harder than the previous panel. At this current density the average RMS value increased by 15 μin and the RMS range broadened considerably, showing a surface that had been roughened substantially by the deposit. Obviously, for this solution, the current densities must be kept low (Fig. 1). Phenolsulfonic acid has been used as an addition agent in acid copper, particularly in the electrotyping industry. In a study of acid copper at the Bureau of Standards[1], R. O. Hull found that phenolsulfonic acid had the effect of hardening and smoothing the deposit and permitting higher current densities. Its action is said to improve after being in contact with the solution for a few days.

A copper solution was prepared in accordance with the standard formula and to it was added 1 g/l (0.13

*Presented at the Forty-first Annual Convention of the American Electroplaters' Society, July 12, 1954.
†Lea-Ronal, Inc., Long Island City, N. Y.



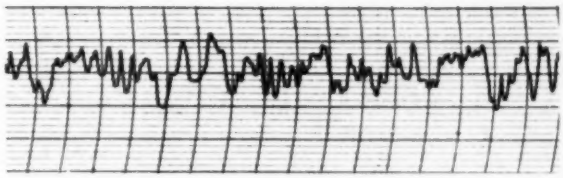
Before plating: average RMS 17.5, frequency factor 46, RMS range 13–23



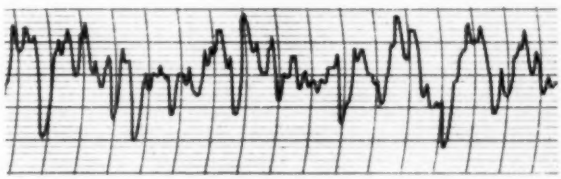
After plating: average RMS 16, frequency factor 35, RMS range 10–25

Reduction in RMS 1.50, reduction in frequency 11

25 asf



Before plating: average RMS 22.5, frequency factor 45, RMS range 14–19



After plating: average RMS 38, frequency factor 40, RMS range 25–56

Reduction in RMS –15.50, reduction in frequency 5

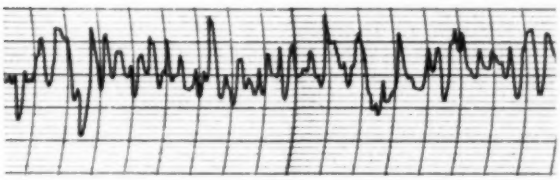
50 asf

Fig. 1. Effect of current density on leveling in the standard acid copper solution. Copper sulfate, 28 oz/gal; sulfuric acid, 7 oz/gal.

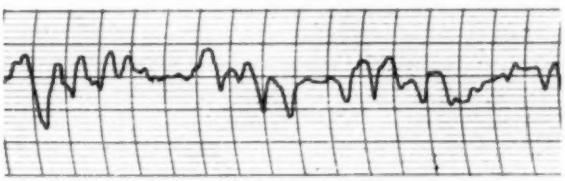
oz/gal) of phenol as phenolsulfonic acid. After aging for three days, a panel was plated using vigorous air agitation at 95° F and 25 asf. The deposit was smoother and harder but had little or no brightness. There was positive leveling to the extent of 8½ μin and the frequency factor was decreased by 20. This addition agent is therefore a moderate leveler and can be used in cases where brightness and high speed are not important (Fig. 2).

Glue has been mentioned previously for use in acid copper and has found large application in the solution used for copper refining. It is said that glue causes grain refinement in the copper deposit. However, Graham[2] describes this refinement as chiefly unidirectional since the grain structure remains columnar. Glue has not achieved importance in decorative plating because it is difficult to control in the solution and is hydrolyzed by the acid to lower proteins and amino acids. The products of hydrolysis may accumulate and cause difficulties. Excesses of glue should be avoided since this condition will cause porosity and brittle plate.

The leveling effect of this material was studied by adding 0.003 g/l glue to the standard copper solution. Using vigorous air agitation, a panel was plated at 95° F and 25 asf. The deposit was semibright, smooth and showed increased hardness with no brittleness. Positive leveling was indicated to the extent of 12 μin and the frequency factor was decreased by 23 units. Glue therefore is considered to be a good leveler. Tests at higher current densities were not considered for glue or phenolsulfonic acid since considerable burning was



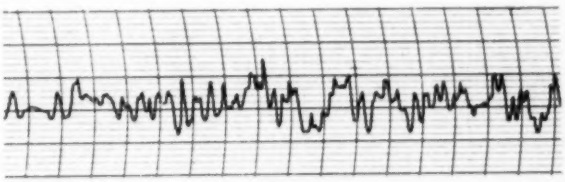
Before plating: average RMS 32.5, frequency factor 45, RMS range 20–44



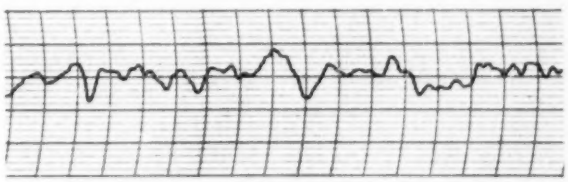
After plating: average RMS 24, frequency factor 25, RMS range 18–32

Reduction in RMS 8.50, reduction in frequency 20

Fig. 2. Effect on leveling of phenolsulfonic acid, 1.0 g/l, in the acid copper solution at 25 asf



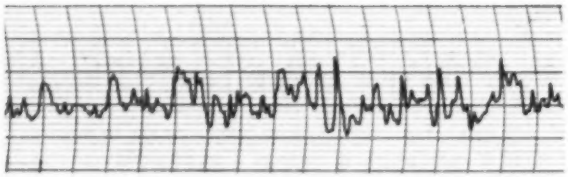
Before plating: average RMS 22.5, frequency factor 45, RMS range 18–26



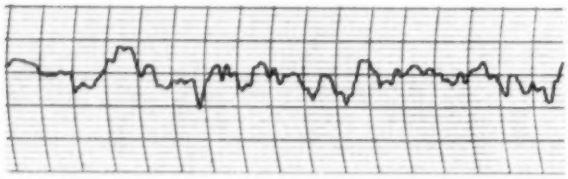
After plating: average RMS 10.5, frequency factor 22, RMS range 5–15

Reduction in RMS 12, reduction in frequency 23

Fig. 3. Effect on leveling of glue, 0.003 g/l, in the acid copper solution at 25 asf



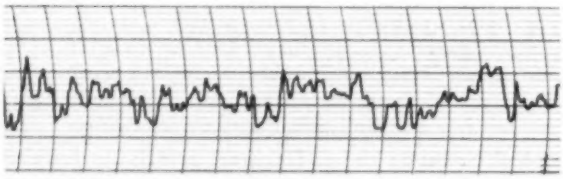
Before plating: average RMS 24, frequency factor 44, RMS range 19–30



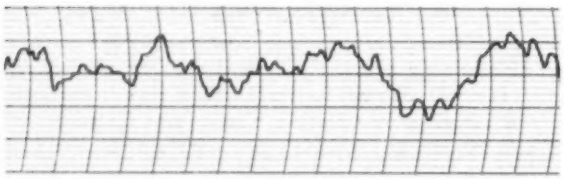
After plating: average RMS 14, frequency factor 26, RMS range 8–19

Reduction in RMS 10, reduction in frequency 17

25 asf



Before plating: average RMS 25.5, frequency factor 47, RMS range 19–36

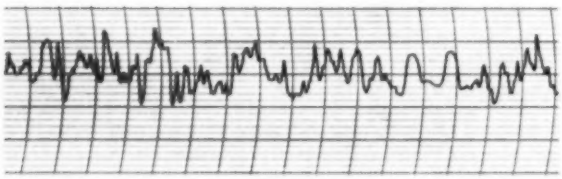


After plating: average RMS 25.5, frequency factor 34, RMS range 17–35

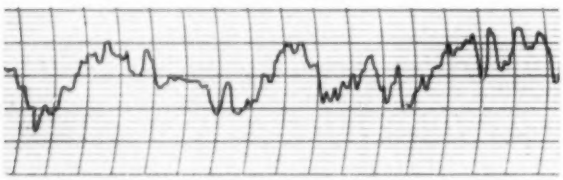
Reduction in RMS 0, reduction in frequency 13

50 asf

Fig. 4. Effect on leveling of thiourea, 0.005 g/l, in the acid copper solution.



Before plating: average RMS 28, frequency factor 45, RMS range 19–38



After plating: average RMS —, frequency factor 33, RMS range 7–52

Reduction in RMS —, reduction in frequency 12

Fig. 5. Effect on leveling of thiourea, 0.01 g/l, in the acid copper solution at 25 asf

produced on the bottom and sides of both the panels even at 25 asf (Fig. 3).

Thiourea has been proposed as a brightener for acid copper by Clifton and Phillips[3]. Combinations of thiourea and a wetting agent called Triton No. 720 were said to produce bright deposits suitable for a subsequent coating of bright nickel without polishing. However, wetting agents present difficulties when using air agitation, due to excess foaming. A combination of thiourea with molasses was later proposed by Keller[4].

Leveling tests were made with thiourea alone using the standard solution with the thiourea concentration equal to 0.005 g/l, vigorous air agitation at 95° F, and at 25 asf. Under these conditions, there was moderate leveling, the RMS being reduced by 10 μin and the frequency factor by 17 units. Another panel was plated at 50 asf with the other conditions held constant. In this case, the RMS reduction was zero, but the frequency factor was reduced by 13, showing only a slight amount of leveling (Fig. 4). This is but one example where leveling was accomplished by a reduction in frequency of the scratches alone, without any reduction in RMS. That leveling does exist under these conditions also is shown by the improved "surface truth" of the plated surface as compared to the unplated surface. "Surface truth," as mentioned in the previous paper, is a term introduced by Gardam and is briefly the ability of the surface to reflect a clear image.

In this thiourea concentration (0.005 g/l), the deposit showed increased hardness and some brightness. There was a lack of uniformity, however, and there was dullness in the center of panel representing the lower current density areas. The thiourea concentration then was raised to 0.01 g/l and another panel was plated at 25 asf and the same temperature and agitation conditions. In this case the deposit was semibright, uniform and hard. The RMS range, however, became so broad that it was not possible to obtain an average RMS reading due to excessive fluctuations in the RMS meter. Under these conditions, therefore, the leveling is negative (Fig. 5). Concentrations of thiourea higher than 0.01 g/l also were tried; however, in all these cases, the deposits were very brittle, nonuniform, and showed a considerable number of striations.

Thiourea and molasses as a combination was studied next in the standard formulation using a thiourea concentration 0.01 g/l and molasses 0.02 g/l. Panels were plated at 25 asf and 95° F using vigorous air agitation. This panel showed that molasses is a desirable addition to use with thiourea as a brightener since the deposit was more uniform and showed better leveling. There was no excessive RMS range as for thiourea alone; and there was some leveling as shown by a small improvement in both the average RMS and the frequency factor, as shown in Fig. 6. At 50 asf, the leveling was still positive although somewhat reduced. The deposit was semibright. This is but another example where the leveling was better at lower

current densities than at high current densities for a given set of conditions.

A further test was run at 50 asf with the molasses content increased to 0.1 g/l. At this concentration, the combination of thiourea and molasses produced moderate leveling with the average RMS reduced by 6 and the frequency factor reduced by 18 (Fig. 7). The deposit was the same, semibright, but the ductility was improved somewhat by this addition of molasses. Higher concentrations of molasses are therefore desirable.

Dextrin was next tried in combinations with thiourea in an attempt to improve brightness and leveling. It was determined that the optimum concentration of dextrin was 0.01 g/l when the thiourea concentration was 0.01 g/l. A panel was plated using the standard formula with such concentrations of thiourea and dextrin, at 50 asf, 95° F and vigorous air agitation.

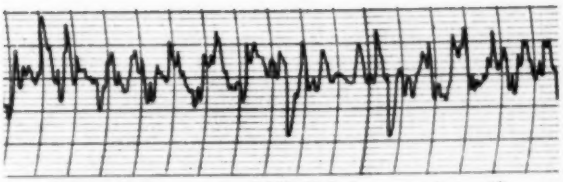
The deposit was considerably brighter with the combination of thiourea and dextrin than with either thiourea alone, or the previous combination of thiourea and molasses. The deposit was harder and showed moderate positive leveling. The RMS in this case was reduced by 5 μin, and the frequency factor by 16 units (Fig. 8).

A recent development in bright acid copper plating[5] uses substitution products of thicurea and a small amount of chloride ion. In order to test the effect of chloride ion in the thiourea and dextrin combination, a solution was prepared with thiourea concentration 0.01 g/l, dextrin 0.01 g/l and HCl 0.012 g/l. A panel was prepared at 50 asf, 95° F and using vigorous air agitation. Results showed that the chloride ion had very little effect on the amount of leveling in the solution under test. In this case, the average RMS was reduced by 7 μin and the frequency factor reduced only by 10 (Fig. 9).

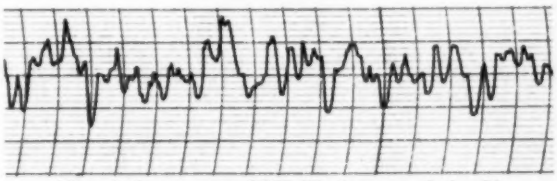
To the above solution Duponol 80 was added in the amount of 0.075 ml/l. This material is a wetting agent that has low foaming properties and therefore can be used somewhat successfully with air agitation. A panel plated under the usual conditions and 50 asf showed that the RMS was reduced by 4 μin but now the frequency factor was reduced by 23 units. There was some loss in brightness, and the hardness remained the same. For leveling, therefore, it would appear that Duponol 80 is a desirable addition to the thiourea and dextrin combination (Fig. 9).

During the course of the work with thiourea, it became apparent that fresh solutions plated brighter and with greater leveling than solutions that had been permitted to stand for any length of time. Furthermore, the longer the solution stood, the duller became the deposit and signs of roughness appeared. It was found also that fresh solutions containing thiourea could be made to simulate complete breakdown merely by heating the solution to 200° F for one hour followed by cooling to normal plating temperature.

It is known that thiourea hydrolyzes in acid solution



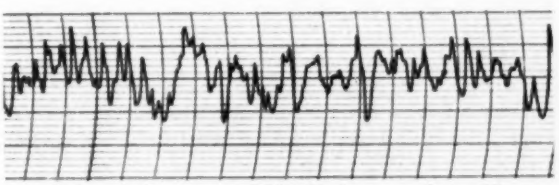
Before plating: average RMS 29.5, frequency factor 47, RMS range 22–38



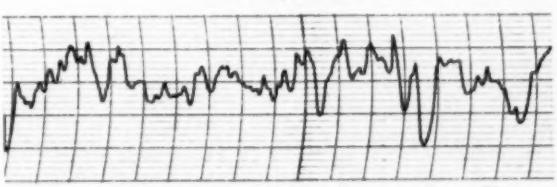
After plating: average RMS 27, frequency factor 34, RMS range 18–36

Reduction in RMS 1.50, reduction in frequency 13

25 asf



Before plating: average RMS 23, frequency factor 46, RMS range 15–33

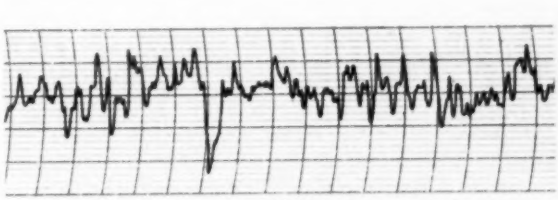


After plating: average RMS 23, frequency factor 39, RMS range 14–37

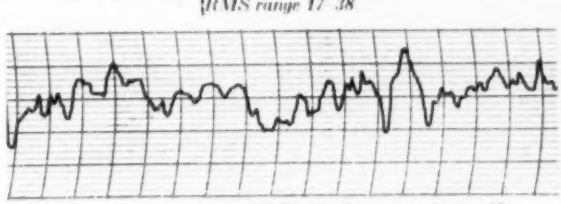
Reduction in RMS 0, reduction in frequency 7

50 asf

Fig. 6. Effect on leveling of thiourea, 0.01 g/l, and molasses, 0.02 g/l, in the acid copper solution.



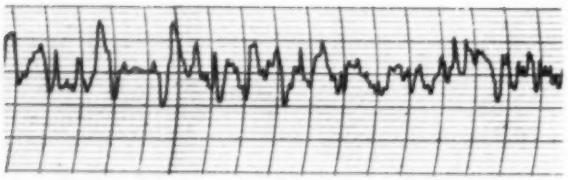
Before plating: average RMS 24, frequency factor 47, RMS range 17–38



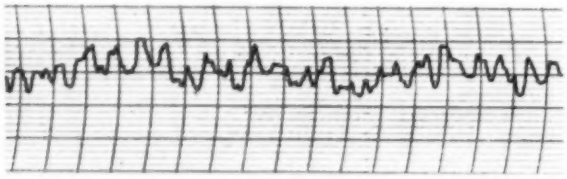
After plating: average RMS 18, frequency factor 29, RMS range 11–32

Reduction in RMS 6, reduction in frequency 18

Fig. 7. Effect on leveling of thiourea, 0.01 g/l, and molasses, 0.10 g/l, in the acid copper solution at 50 asf



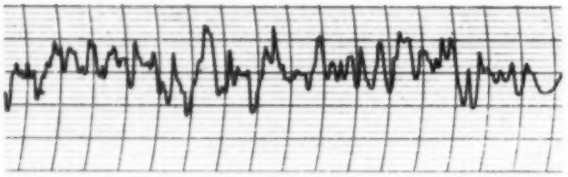
Before plating: average RMS 23, frequency factor 47, RMS range 18–32



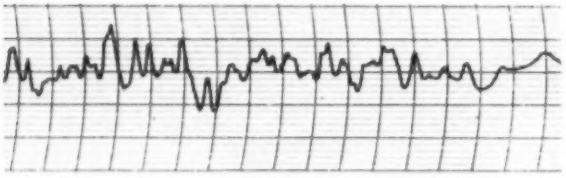
After plating: average RMS 18, frequency factor 31, RMS range 10–25

Reduction in RMS 5, reduction in frequency 16

Fig. 8. Effect on leveling of thiourea, 0.01 g/l, and dextrin, 0.01 g/l, in the acid copper solution at 50 asf

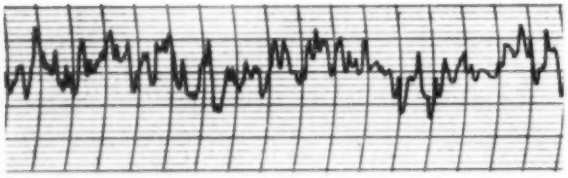


Before plating: average RMS 27, frequency factor 45, RMS range 20–38

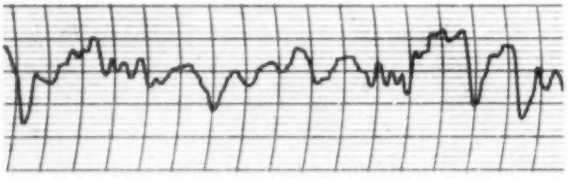


After plating: average RMS 20, frequency factor 35, RMS range 12–29

Reduction in RMS 7, reduction in frequency 10
50 asf



Before plating: average RMS 22, frequency factor 47, RMS range 19–30



After plating: average RMS 18, frequency factor 24, RMS range 10–25

Reduction in RMS 4, reduction in frequency 23
50 asf with 0.075 ml/l of Duponol 80

Fig. 9. Effect on leveling of thiourea, 0.01 g/l, dextrin, 0.01 g/l, with HCl, 0.012 g/l, in the acid copper solution.

and breaks down to ammonia and carbon dioxide in accordance with the following formula:

$$NH_2CSNH_2 + 2H_2O \rightarrow 2NH_3 + CO_2 + H_2S$$

The rate of breakdown increases as the solution temperature increases and, consequently, these solutions should never be permitted to overheat.

In choosing addition agents for acid copper, it is most important to determine the stability of the materials under these highly acid conditions. If the material does hydrolyze, it is important to know not only the rate of hydrolysis, but also the effects of the products of breakdown on the deposit. For example, dicyandiamide has been found to exhibit excellent brightening action in acid copper. This material cannot be used, however, since it hydrolyzes rapidly and forms harmful breakdown products. Other materials in this class such as nitriles and other cyanagen compounds have been found to work as well, but all were discarded due to their hydrolysis or breakdown in the plating solution.

Lea-Ronal Acid Copper Process

Two proprietary materials have recently been placed on the market.* To test their effects separately on the standard solution, 1 per cent of the primary brightener (AC-1) alone was added and panels plated at 25 asf and 50 asf with the usual plating conditions. The deposits were fairly bright and showed some leveling. At 25 asf the average RMS was reduced by 3 μin and the frequency factor reduced by 19 units. At 50 asf, the average RMS *increased* by 1 μin but the frequency factor decreased by 20 units. Both surfaces showed improved "surface truth" mostly due to improved frequency factor. Once again the leveling was slightly better at low current densities than at high current densities (Fig. 10).

Next, the combination of the two materials as recommended by the manufacturer was tested under the usual plating conditions. One per cent of the primary brightener, AC-1, and 0.25 per cent of the booster brightener, B-20, were added and panels plated at 25 asf and 50 asf. This combination of brighteners was by far the best of all the materials tried for both brightness and leveling. At 25 asf the RMS was reduced by as much as 26 μin and the frequency factor reduced by 38 units. At 50 asf, the leveling was only slightly less; the average RMS being reduced by 24 μin and the frequency factor reduced by 34 units (Fig. 11). The brightness was better than any of the former combinations. These materials are perfectly stable in solution and are not subject to hydrolysis or breakdown even at elevated temperatures. The stability was verified by heating the solution for one hour at 200° F followed by cooling to 95° F and then plat-

*Lea-Ronal Copper Gleam Process, Lea Ronal, Inc., Long Island City, N. Y. Patent applied for.

ing a panel. The panel from the solution after the heating treatment was found to have the same characteristics as one plated from a fresh solution. No effect at all was found on solutions that aged for any length of time.

To determine the effect of temperature on these solutions, a test was run at 78° F using the Lea-Ronal brightener combination and plating at 50 asf. The lower temperature was detrimental to leveling because the RMS reduction was only 16 and the reduction in frequency is 13 units (Fig. 12).

The effect of varying the concentrations of metal and acid was studied, keeping all other variables constant. The solution composition was:

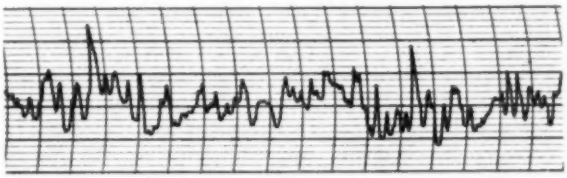
Copper sulfate	20 oz/gal
Sulfuric acid	20 oz/gal

A test was now run with this solution using the Lea-Ronal brightener combination and plating at 95° F and 50 asf. In this case, the RMS reduction was once again considerably less than that obtained when using the standard solution used for the previous tests. The RMS reduction was 9½ μin and the reduction in frequency was 18 units. These results showed that leveling is best with this solution when copper contents are high and acid contents are lower (Fig. 13).

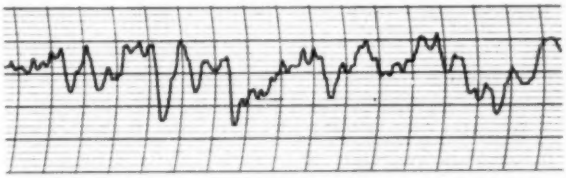
Final Discussion

It has been shown that cyanide copper solutions containing certain addition agents can exhibit leveling when plating on a surface having an RMS below 10 μin. On surfaces of higher RMS values, the leveling is negative. Acid copper solutions, on the other hand, can exhibit various degrees of leveling regardless of the RMS of the surface being plated.

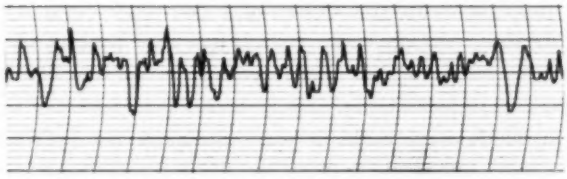
Elaborating on the introduction to the theoretical discussion presented in the previous paper on cyanide



Before plating: average RMS 30, frequency factor 46, RMS range 18–52



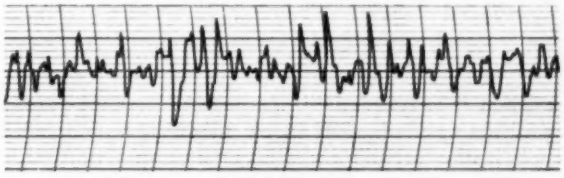
After plating: average RMS 27, frequency factor 27, RMS range 18–38
Reduction in RMS 3, reduction in frequency 19
25 asf



Before plating: average RMS 26, frequency factor 47, RMS range 18–36

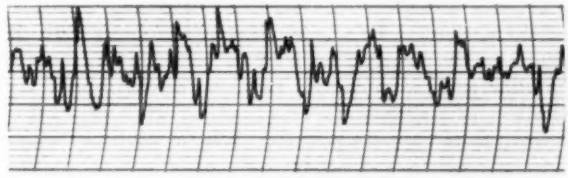
After plating: average RMS 27, frequency factor 27, RMS range 18–38
Reduction in RMS –1, reduction in frequency 20
50 asf

Fig. 10. Effect on leveling of proprietary brightener AC-1, 1 per cent, in the acid copper solution.

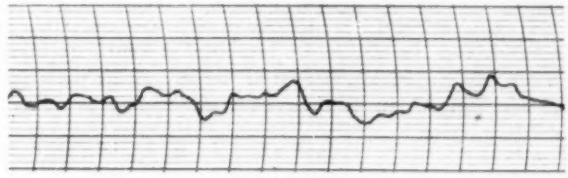


Before plating: average RMS 38, frequency factor 47, RMS range 28–52

After plating: average RMS 12, frequency factor 9, RMS range 6–18
Reduction in RMS 26, reduction in frequency 38
25 asf

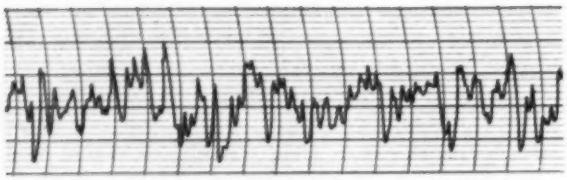


Before plating: average RMS 34.5, frequency factor 47, RMS range 24–39

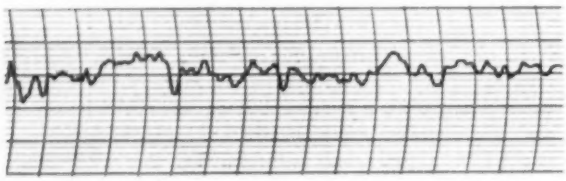


After plating: average RMS 10.5, frequency factor 13, RMS range 4–18
Reduction in RMS 24, reduction in frequency 34
50 asf

Fig. 11. Effect on leveling of proprietary addition agents AC-1, 1 per cent and B-20, 0.25 per cent, in the acid copper solution at 95° F.

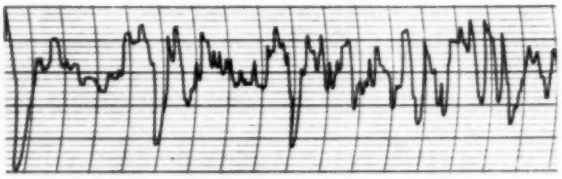


Before plating: average RMS 31.5, frequency factor 48, RMS range 20–45

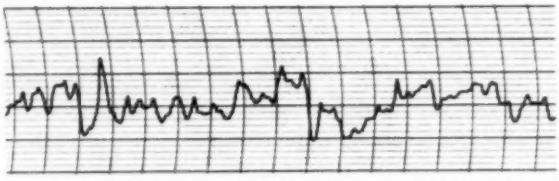


After plating: average RMS 15.5, frequency factor 25, RMS range 8–22
Reduction in RMS 16, reduction in frequency 13

Fig. 12. Leveling obtained with proprietary addition agents at 78° F at 50 asf



Before plating: average RMS 32, frequency factor 45, RMS range 22–44



After plating: average RMS 23.5, frequency factor 27, RMS range 14–34
Reduction in RMS 9.5, reduction in frequency 18

Fig. 13. Leveling obtained in a low metal-high acid copper solution with proprietary addition agents at 95° F and 50 asf. Copper sulfate, 20 oz/gal; sulfuric acid, 20 oz/gal

copper, it is believed by the authors that the proper addition agents in acid copper plating solutions cause polarization around a scratch. Polarization plus other effects, combine to make the potential difference between the anode and the depth of the scratch greater than the potential difference between the anode and the top surface of the scratch. The net result is that more metal will deposit into the recess than on the top of the scratch thus producing a filling-in process or the phenomenon called leveling.

Referring to Fig. 14, leveling will occur when $e_2 + \Delta e$ is greater than the e_3. This will be true only when e_2 is more negative than e_1.

It is interesting to note that cyanide solutions of metals below hydrogen exhibit poor leveling properties whereas acid solutions of the same metals can exhibit good leveling. To explain this behavior, one can return to the theory that leveling occurs when there is a difference in potential between the hills and the valleys of a surface imperfection and when this difference has the correct polarity. In acid solutions where the deposition potentials and therefore the plating voltages are low, a small difference of potential will make a sizable percentage variation. In other words, the ratio between the potential differences around a scratch and the deposition potential is relatively high when the deposition potential is low—as in the case of acid copper. In the case of cyanide copper, however, the deposition potentials are higher than in acid copper and the ratio mentioned above will therefore be correspondingly lower, thus, referring to Fig. 13, let us assume for the sake of simplicity that Δe is the same for both acid and cyanide copper solutions. This being the case, $\frac{\Delta e}{e_3}$ will be greater for acid copper since e_3 is a lower value; and the ratio will be lower for cyanide copper, since e_3 is then a higher value.

In order to make the ratio the same in both cases, it would be necessary in cyanide solutions for polarization and other effects to be much greater to make the hill and valley potential difference greater. For example, if in a hypothetical case, an acid copper solution is plating at one volt and the potential difference between the hills and valleys of a scratch or Δe is 0.2 volt, the ratio becomes $\frac{0.2}{1}$ or 20 per cent. In a cyanide copper solution operating at 2 volts, in order to have the same ratio, it would be necessary to have double the previous potential difference, or 0.4 volts. Thus the factors making for the potential difference between hills and valleys, must be twice as effective in the cyanide solution as compared to the acid solution. If addition agents are used to accomplish the leveling in cyanide solutions, they must perform a much greater function than they do in acid solutions. This simplified explanation is presented as a working theory in order to attempt to justify the fact that it is so difficult to produce leveling in cyanide solutions by using addition agents.

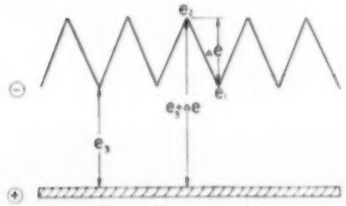


Fig. 14. Potential difference between anode and surface and base of scratches on cathodes

In a similar manner we can explain why leveling is better at lower current densities than at higher current densities for a given solution. At higher current densities, the plating voltages are higher and the increase in potential difference between hills and valleys is not

so great as the increase in voltage. In other words, e_3 increases more than does Δe at higher current densities making the ratio that much lower.

Regarding frequency determinations, the difficulties in evaluating the magnitudes of the frequency factor numbers presented in the data should be pointed out. It must be remembered that these factors were obtained by counting the moves of the stylus for one inch of chart length. If two inches of chart length were used the reduction in frequency factors would be doubled. In addition, another instrument with a finer stylus may reveal many more scratches on a given surface than the instrument used in this study, which would increase the reduction in frequency factor. For this reason, the numbers presented as the frequency factors were only used as guides to help evaluate leveling. These factors as presented here are merely numbers with no definite dimensions.

An important point is that leveling can take place by a reduction in frequency of the scratches on a surface even though there may be no reduction in RMS. That leveling does take place in this case can be seen visually by evaluating the "surface truth" before and after plating.

"Surface truth" is taken as an average of all the factors that make up the irregularities of the surface. This includes RMS values, frequency factors, extremely fine scratches not revealed by the surface analyzer, and very large scratches or waves. A good method, therefore, for judging the leveling power of a solution on all of these irregularities, would be to evaluate the "surface truth" before and after plating.

It is believed that much more work is needed in the evaluation of leveling and that an instrument can be constructed along the lines set down by Gardam for measuring "surface truth". With an instrument of this type it would be possible to judge the overall average of the combined factors contributing to leveling.

It has been shown that for acid copper solutions it is entirely feasible, by using the proper addition agents, to achieve the savings mentioned in the introduction to this paper. By taking advantage of brightness and high leveling properties, there should be (a) large savings in metal costs, by using copper for leveling rather than nickel, (b) savings in polishing costs by reducing or possibly eliminating polishing operations, (c) and savings in plating costs by making it possible to plate copper-nickel-chromium without intermediate buffing.

Acknowledgment

The authors wish to express their appreciation to Dr. Louis Weisberg, consultant, for his helpful suggestions for the write-up of both papers. Thanks are due Dr. H. L. Kellner of the Lea Manufacturing Company for assistance with the preparation of slides and also Mr. S. L. Doughty of the Lea Manufacturing Company for preparing the panels.

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DISCUSSION

Dr. D. G. Foulke (Hanson-Van Winkle-Munning Co., Matawan, N. J.): This is addressed to Mr. Nobel: I assume that the same thickness of deposit was plated at 25 asf and 50 asf. Was this the same as for the cyanide baths, reported earlier, i. e. 0.001 inch?

Mr. Nobel: That is correct.

Dr. Foulke: The second question is for Mr. Ostrow. In the second paper the use of wetting agents was reported as being helpful in accomplishing leveling in the acid system. Was anything done with respect to wetting agents in the cyanide system?

Mr. Ostrow: No study had been made on the effect of wetting agents in the cyanide system, that is, not at the time this paper was prepared.

Dr. Walter R. Meyer (Enthone, Inc., New Haven, Conn.): What are the effects of mercaptobenzothiazole in acid copper baths—is it a material that has been recommended as a brightener? If leveling were accomplished in acid copper solutions according to theory, there should be an overall increase in cathode polarization. Were any measurements made of cathode polarization? Normally there is none in the average acid copper bath.

Mr. Nobel: In regard to the second question, polarization studies were not made, in this study we were merely interested in leveling as measured on the Brush Surface Analyzer.

Regarding your first question, mercaptobenzothiazole was not used. We limited ourselves to addition agents which were fairly well known and which had been reported previously.

Mr. Ostrow: I think a study has been made and a paper has recently been published by the Electrochemical Society, about polarization effects at the cathode, using glue as an addition agent.

Mr. Ray C. Steffey (American Lava Corporation, Chattanooga, Tenn.): Immersion deposits are one of the big evils of acid copper baths. What can be done other than introducing the work alive, to eliminate or hold to a minimum this poorly adhering deposit? I had in mind silver.

Mr. Nobel: Immersion deposits generally, although this is beyond the scope of our study, can be prevented by using a proper strike. If plating copper on steel, we generally use a cyanide strike. We have no actual experience with plating acid copper on silver.

MR. WILLIAM P. INNES (MacDermid, Inc., Waterbury, Conn.): I think that we are probably working outside the limits of the stylus instrument for measuring surface roughness. I should like to compliment the authors for their fine work. However, I think what they have done should be verified. That would be possible in the near future using the interferometer by which one measures surface roughness by means of two different phases of light. I think in the cyanide bath where the RMS was 10 or less, you actually roughen the deposit, but bring the scratches closer together, so the stylus cannot give a true picture of surface roughness. With a stylus instrument, when you get down to 2 μin. I think you are just about at the limitation of the instrument.

MR. OSTROW: In reference to Mr. Innes' remarks, we pointed out that "surface truth" as presented by Gardam was a more justifiable measure of leveling than is the Brush Analyzer. In actual production on zinc die castings some form of leveling is obtained and it has been our aim to draw attention to the concept, that there is a contributing factor other than reduction in RMS that may take place in leveling, namely frequency.

MR. J. M. WELLER (Minneapolis Honeywell, Minneapolis, Minn.): Maybe this question is beyond the scope of the paper, but did any of the acid copper deposits show any promise with respect to ductility? Was any study made of the physical properties of the deposits from any of these acid baths as, for example, the phenolsulphonic acid addition agent.

MR. NOBEL: We did not make any actual hardness measurements. However, in all cases where addition agents were used the deposit became harder. We merely made a rather rough and ready test. We bent the deposit 180° and observed cracks or any "crys" that were obtained.

MR. INNES: In plating zinc-base die castings, one must take into consideration that the surface roughness is probably less than 1 RMS, and when you clean you do remove metal which would account for some scratch removal.

MR. CLARENCE E. MANGE (C. E. Mange Dev. Lab., St. Louis, Mo.): I would like to know whether there is any method for testing the addition agents in the acid copper bath. Are they critical and how can the bath be maintained?

MR. NOBEL: You will note that the quantity of addition agents in all of these solutions is in all cases very low and unfortunately in most cases, there is no actual chemical method of analysis, as there are for the major chemical constituents.

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INDUSTRIAL APPLICATIONS FOR METALLIZED NONCONDUCTORS*

HAROLD NARCUS†

Introduction

While the literature reveals innumerable applications for metallizing nonconductors for decorative purposes, of greater interest and value are the many industrial applications. Reference is made to the employment of metallized nonconductors, specifically plastics, glass, quartz and ceramics, in the fields of printed circuitry, electroforming (e. g., manufacture of slush molds, spraying masks, etc.), the electronic field and in certain miscellaneous fields such as medicine and dentistry.

Since the conclusion of World War II, industrial applications for metallized nonconductors have increased to such an extent that the methods utilized for carrying out these specialized procedures have become an important part of the postwar government defense operations, in addition to those of private industry. Therefore, it is the purpose of this paper to discuss the more important applications for metallized nonconductors with particular emphasis on the methods employed, the specially prepared chemical formulations necessary for the achievement of the desired results and, finally, the required electroplating techniques.

Printed Circuitry

The wide interest shown in printed circuits perhaps was stimulated by the concern of the armed services over the increase in weight, bulk, and complexity of equipment particularly in aircraft. Today, through the medium of printed circuitry, electronic equipment has been made smaller, lighter, less complex, without any loss of efficiency.[1,2] Figures 1 and 2 clearly illustrates the simplicity of an electronic circuit achieved by utilization of printed circuit techniques. Indeed, printed circuits have emerged from the electronic laboratory to become an important part of electronic devices produced in mass. Although many of the techniques in use at the present time were known and employed to advantage many years ago, printed circuitry as used today is a comparatively recent accomplishment. The employment of printed electronic circuits enables one to condense the size of electronic assemblies, to mechanize electronic wiring and to re-

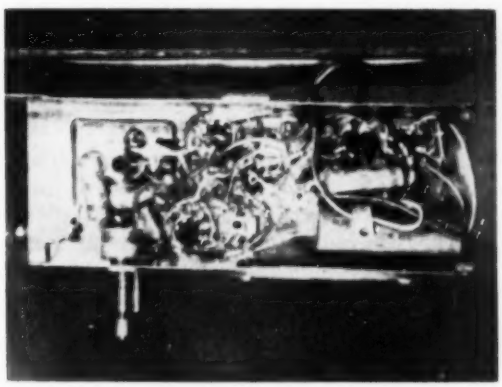


Fig. 1. Conventional chassis wiring

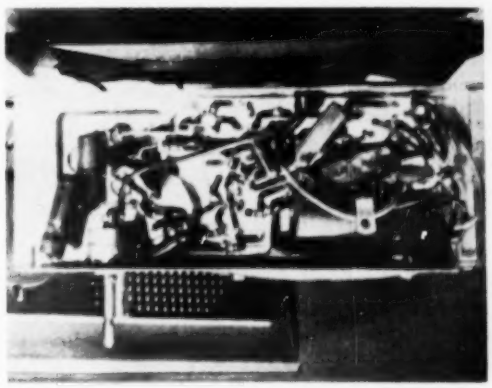


Fig. 2. Chassis with plated circuit

*Presented at the Forty-first Annual Convention of the American Electroplaters' Society, July 12, 1954.
†President and Technical Director, Electrochemical Industries, Inc., Worcester, Mass.

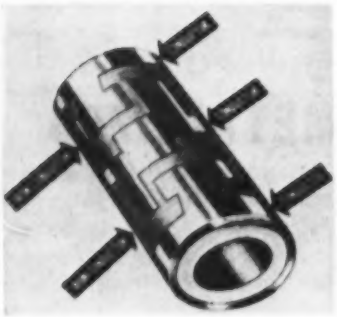


Fig. 3. Rotating commutator with surfaces plated into grooves

duce wiring essentially to two dimensions for less complexity. Electroplating is one of the many tools used for reproduction of a circuit design upon a surface since, of the many methods which are classified as acceptable printed circuit techniques, it is an essential part of the greater percentage of them. While, generally speaking, the various methods for applying printed circuits can be divided into 6 principal classes —painting, spraying, chemical deposition, vacuum processes, die-stamping and dusting and painting— each capable of producing an efficient printed circuit; in some applications, however, it is necessary frequently to increase the thickness of the initially applied coating mainly to improve the electrical conductance, mechanical and other properties. Electroplating offers the most practical way to achieve these desired results.

The electrodeposition of selected metals on initially formed films on plastics is perhaps more common when these organics are integral parts of the printed circuit than when ceramics are used because of the fact that a firing of the applied coating, with its subsequent advantages, cannot be used to increase conductivity and other properties in the case of the plastics as with the ceramics. However, even in the latter case, electroplating is being used for several special applications to be discussed later in this paper. That phase of printed circuitry, which involves the employment of electrodeposits on plastic surfaces, warrants the closest attention. In addition, special glass and quartz components, which must be treated similarly to plastics, because of their relatively low distortion temperatures, also warrants discussion.

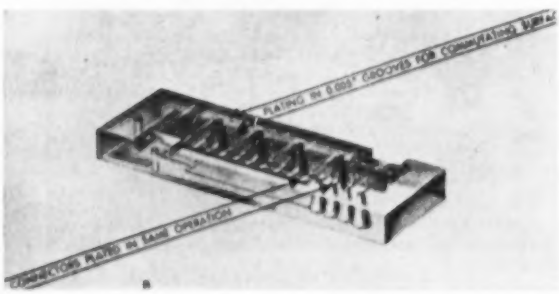


Fig. 4. Flat-type commutator with three connecting circuits

Plastics

While metals may be applied to plastics used in electrical circuits by cementing methods, stamping, inlaying, etc., very simply and cheaply, certain special requirements necessitate other procedures. More commonly, metal is applied by electroplating to form circuits on plastics especially where intricate shapes consisting of a combination of a conductor and a nonconductor are necessary or in which thin layers of metal are applied.

There is a wide variety of methods for coating the plastic component with the initial film prior to electroplating. Some have proven unsatisfactory or of limited application because of high costs, poor adhesion, porosity and even inferior mechanical properties. Some of the methods require special and expensive equipment. The procedures for applying the initial conductive film have been covered rather extensively in the literature in articles published by this author and others.[4] These methods are classified as metal spraying, vacuum deposition, chemical reduction and metal dusting and painting.

Metal-spraying methods still are being used to a limited extent, but they offer the following disadvantages: burning or softening of the plastic, in spite of the low fusible metal used, and the sandy effect produced on the surface. The method is satisfactory, however, when excessively thick metal layers are desired in a short time.

The vacuum deposition (metal evaporation) method has proven to be an excellent method for decorative purposes especially for large pieces but can be slow, tedious and expensive in printed circuitry. The same holds true for the allied process, cathode sputtering.

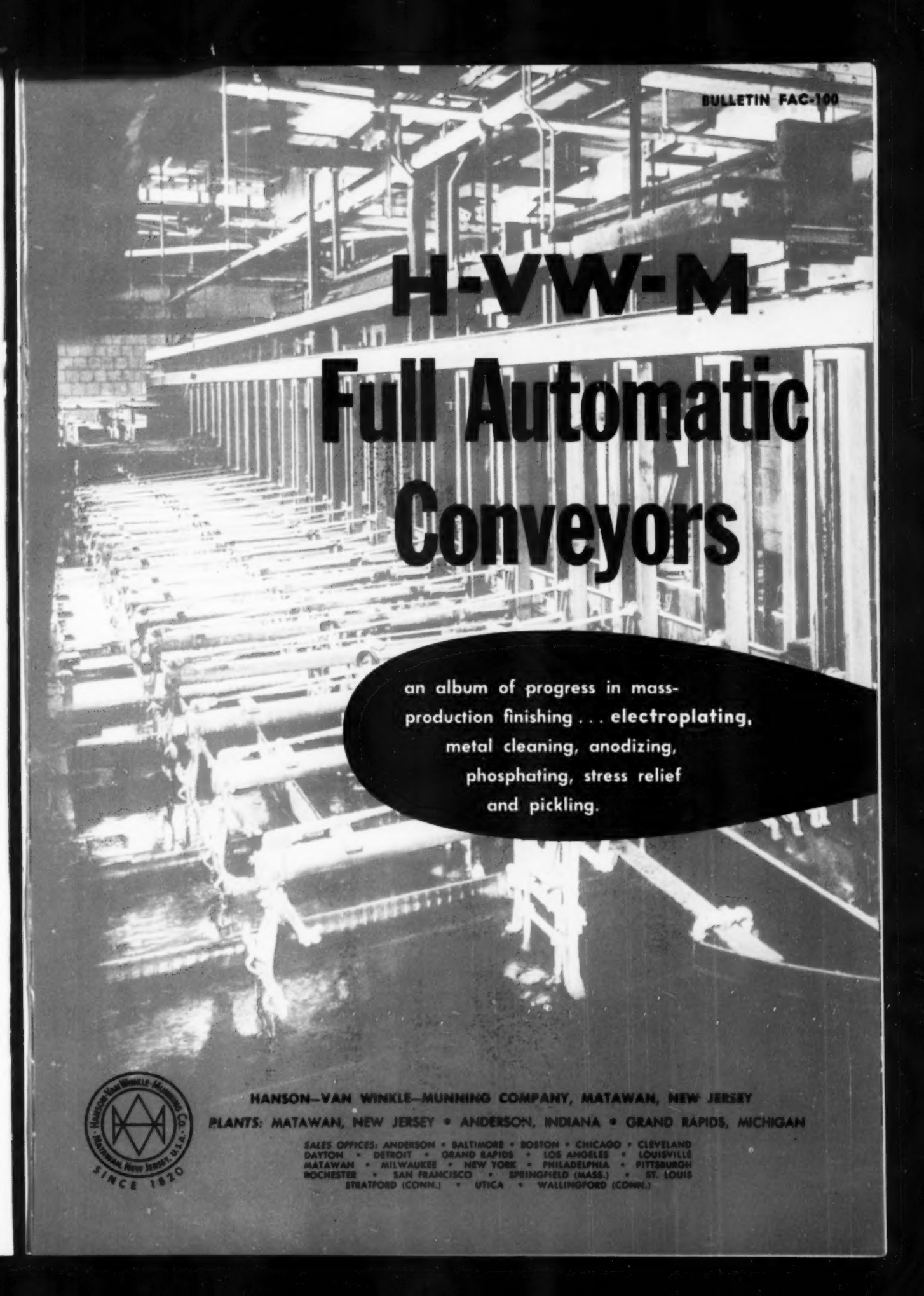
Chemical reduction is best for small objects especially where complete envelopment of the part is required but offers many difficulties when stencils or masks are used because, being a wet-process, the solution tends to seep under the mask. There is also the disadvantage that the chemical reduction method requires chemical pretreatment of the plastic surface.

It is important to point out that the foregoing methods still find a place in printed circuitry but only in certain special applications.

Figures 3 and 4 show a most versatile method for the production of printed circuit designs. It involves the complete coverage of the nonconductor with metal followed by removal of selected portions of the metal deposit. This removal may be accomplished by chemical or mechanical means. The latter is more efficient and more commonly used.

Figures 5, 6, and 7 show several applications for plated plastics where the combination of a conductor and a nonconductor is achieved by electrodeposition.

While painting methods would, at the outset, appear to be crude and cumbersome and even obso-



BULLETIN FAC-100

H-VW-M Full Automatic Conveyors

an album of progress in mass-production finishing . . . **electroplating,** metal cleaning, anodizing, phosphating, stress relief and pickling.

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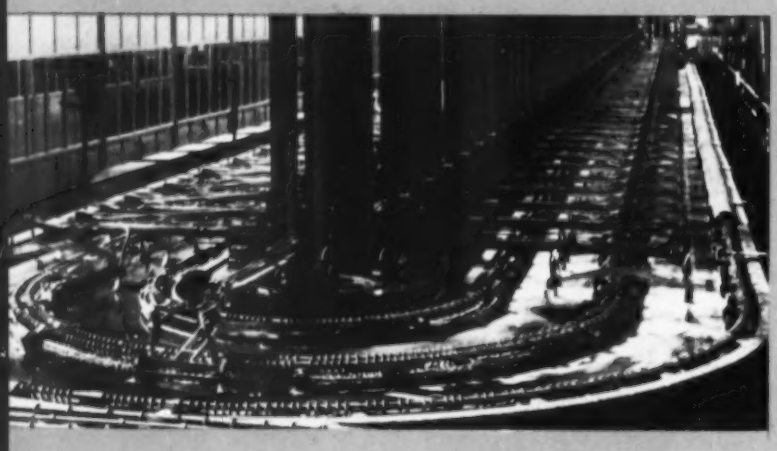
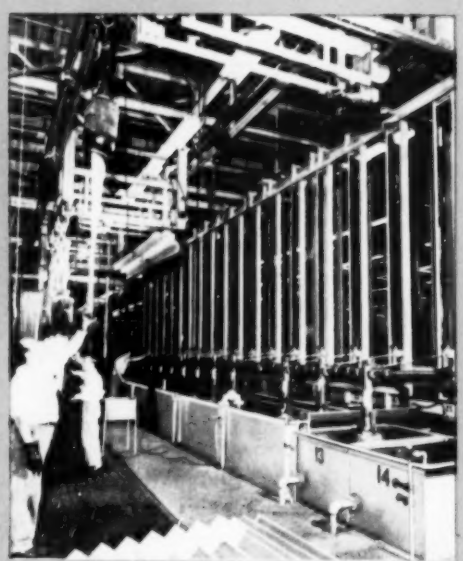
The requirements of the inorganic metal finishing industry place a premium on the operational flexibility, broad range of application, and the engineered precision of its equipment. Recognizing this, H-VW-M design engineers have placed special emphasis on incorporation of all of these features—in maximum degree—in H-VW-M full-automatic metal processing conveyors.

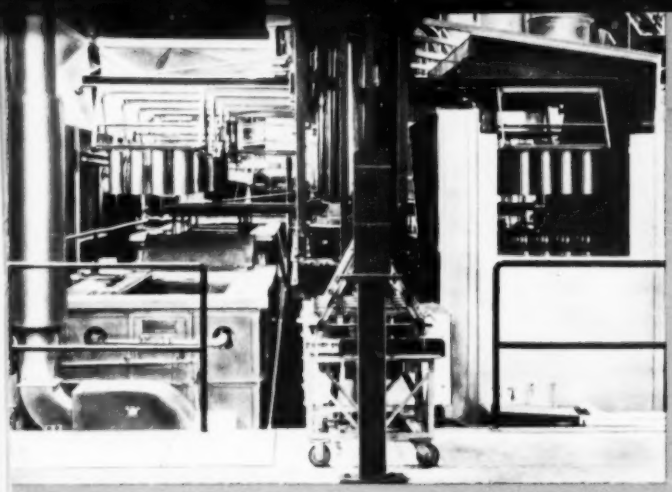
Check the following pictures and their brief story-captions carefully, for they have been particularly selected to indicate the scope of application of H-VW-M Full Automatic Conveyors. *Right here* are the performance-proved, engineered answers to a host of common problems in volume metal finishing.

from the largest to the smallest . . . in processing parts and automotive steel stampings this full automatic plating conveyor takes 'em all. This one machine has an operating solution capacity of 84,000 gallons—one of the world's largest for a single unit.

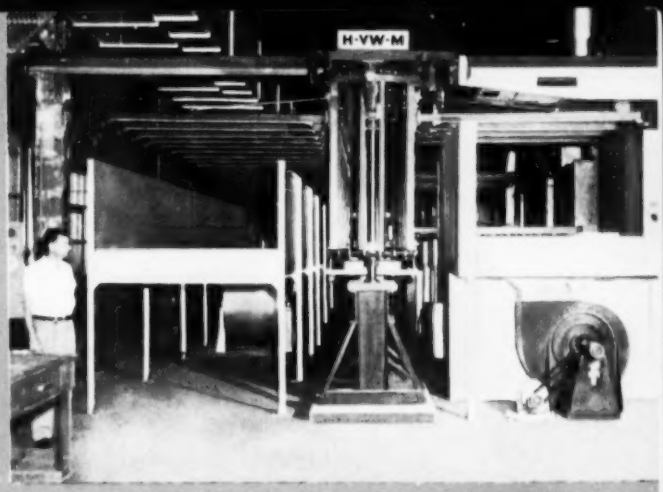




highest lift . . . for a return type conveyor, raising 300-lb. steel propeller blades a full ten feet during zinc plating cycle. To obtain correct blade balance and heavy zinc deposit, the blade transfers automatically to auxiliary conveyor chain for required recycling and automatic reload.

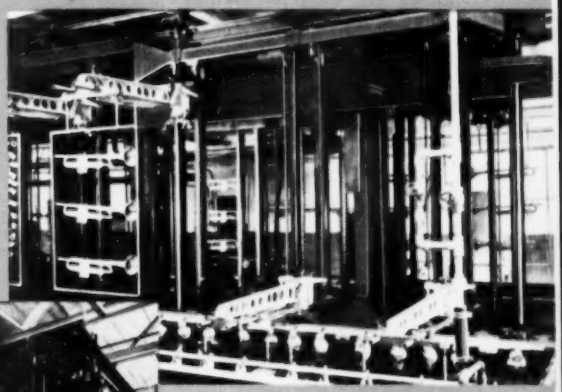


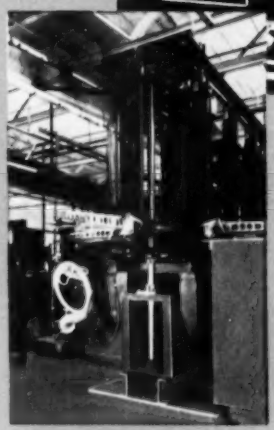
automation in stress relief . . . as well as other treatments can be accomplished through intermittent cycling, as with these steel shell cases which move between oil bath (left) and hot-air blast dryer. *Automatic loading* from and into the same truck, shown in foreground.



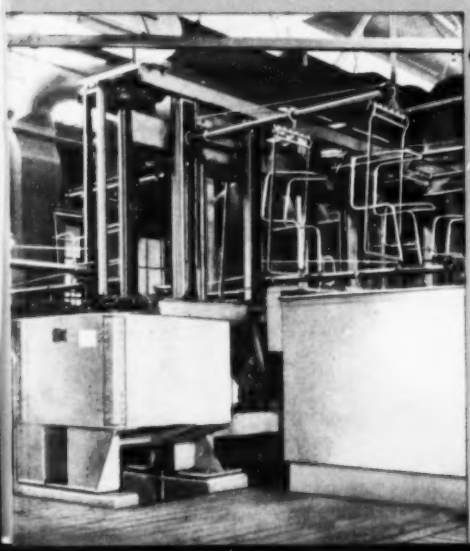
then to paint prep . . . where another H-VW-M conveyor cleans and pickles, drys and cools these same 300-lb. carrier loads of shell cases prior to spray painting. A typical return-type full-automatic does the job, loading and unloading at opposite end of conveyor. Cooler at left, 300°F. dryer at right.

where precision is paramount . . . and minute tolerances of a uniform deposit must be maintained on each separate part, each carrier operates independently. Proper instruments, variable resistors, bi-polar circuits, and mechanical agitation of work in solution are all handled through independent controls on each carrier, as shown in inset.

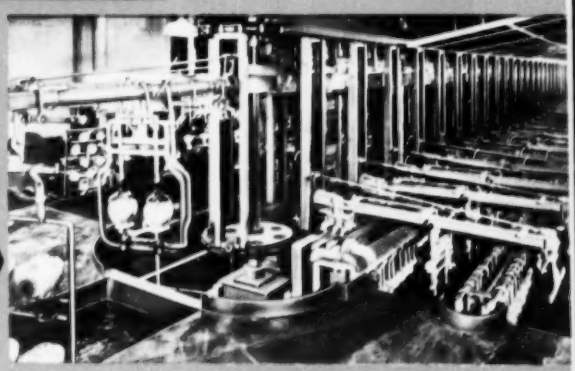




variable load capacity . . . is an essential when the same machine handles musical instruments of all shapes and sizes. Note the interior anode arrangement designed to allow complete plating of the all-important bellmouth. Inset shows a complex-shaped Sousaphone after heavy silver deposit.

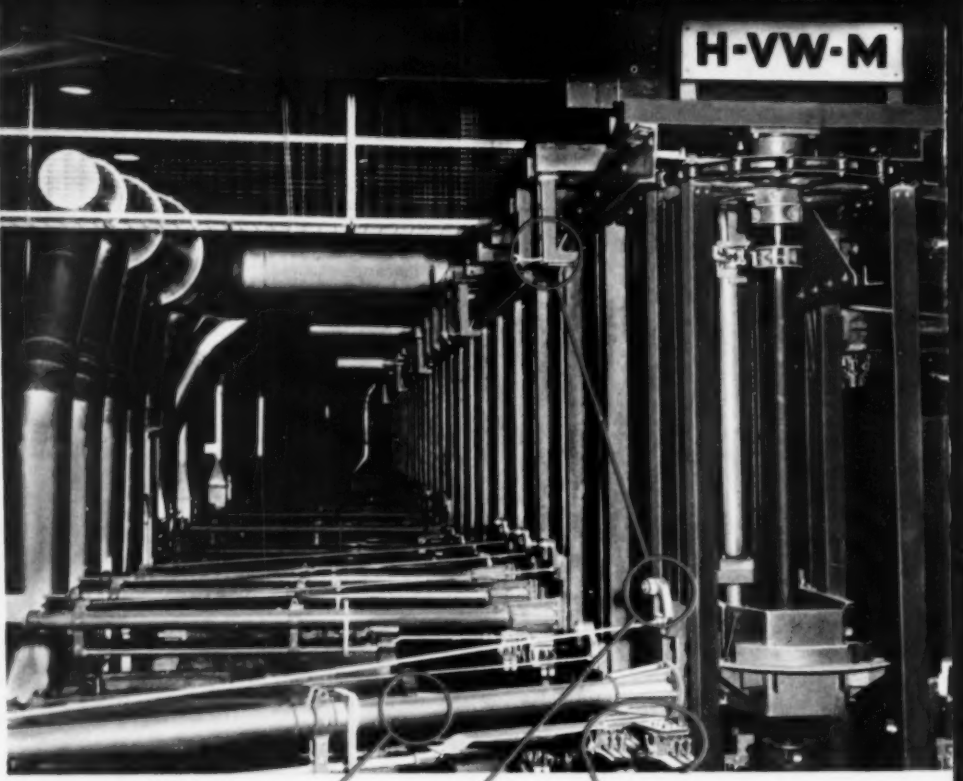


adaptable for bulky loads . . . this high-lift, full-automatic conveyor handles clumsy, tubular steel furniture frames with ease. Notice the long arms, with adequate spacing between them to accommodate the bulkiest and most irregular shapes.



plating versatility . . . is the answer to the plating requirements of these attractive modern coffee makers. Like many other holloware appliances they are plated inside and outside by separate circuits. Notice the internal anode feature on the racks, and current collector fingers at the framework end of the arms.

and for features



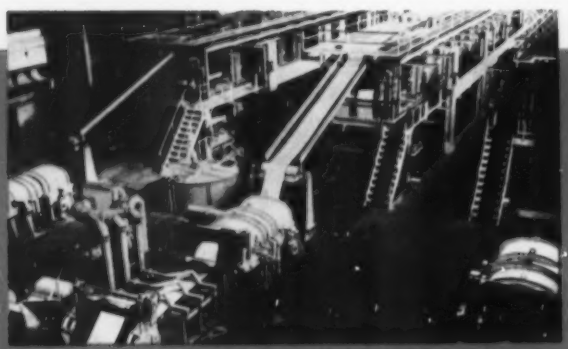
Highlighted in the photo are the engineered keys to flexibility of operation, multiplicity of applications, and versatility of product and treatment range. All of these features are incorporated in the H-VW-M Full Automatic Electroplating Conveyor.

1. The elevator lifting member (not visible) is a *first* with H-VW-M, raising carriers at all transfer points by means of a single track or flipper. Any station on the conveyor can therefore become a transfer point between adjacent treatments. In combination with the rigid carrier arm, this elevator method has permitted a wide scope of applications, unlimited by space, height, weight, or lift. Loads can be tipped or rotated in solution, or tipped to drain during transfer. Automatic transfer to an auxiliary chain system, dolly, or truck is also possible; or, for specific requirements, automatic load and unload on permanent racks is within the scope of application.

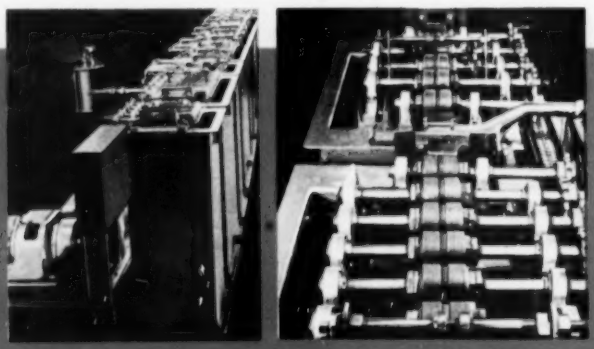
2. Rugged pipe-arm carrier is sturdily built for support of heavy or light loads, yet engineered for free movement in guide channels, high or shallow lifts.

3. The overhead "by-pass" track will hold carrier loads in elevated position in by-passing certain treatments. Can be set manually or automatically to engage the roller of each carrier. This feature is also used to lock all carriers in elevated position for service of tank or solution. Another of the many combinations possible with this free-moving rigid arm and by-pass mechanism is serving as a pick-up point during travel through a plating bath, thereby providing two or more distinct plating time intervals, or two or more controlled deposits. Continuity of production, rate of flow, and other essential operating conditions would remain undisturbed.

4. Unique, self-lubricating, spring tension collector fingers for both positive and negative DC circuits. Here the inside and outside of shell cases are zinc plated, each on a separate circuit.



In the continuous plating of metals H-VW-M has pioneered. The strip steel production operation shown includes an H-VW-M tin plating line which continually deposits an even coat of tin on the steel strip at speeds up to 1000 feet per minute.



Here is another good example of the versatility of H-VW-M automatic electroplating equipment—a specially engineered conveyor for depositing a chromate finish on zippers already fastened to cotton tape. Entire operation is automatic.

H-VW-M

HANSON–VAN WINKLE–MUNNING COMPANY, MATAWAN, NEW JERSEY

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lete, they have proven to give excellent results in printed circuit techniques. In fact, it can be stated that the application of a coating, consisting of a binder and a conductive material with certain improvements made in the formulation, has proven to be an efficient and flexible procedure.

For many years, wax was used as the binder and graphite, the conductive material. This combination still is being used today in electrotyping and in the manufacture of certain classes of molds but cannot be used if the adherence of the subsequent electroplated metal coating to the plastic is an important factor. Metallic powders (viz., copper, aluminum, bronzes and other base metals) show many improvements but still do not increase adhesion of the metal deposit, only permit its more rapid formation in the electroplating bath. Silver powders incorporated with a suitable binder, offer the best combination for printed circuitry. Silver has the highest conductivity of all metals. Furthermore, copper and the other base metals form metallic salts with the organic binder, the mixture becoming unusable because the corrosion products of copper and the other base metals, which may form as the film dries; these are nonconductors whereas all corrosion products of silver (for example, silver sulfide, silver chloride, etc.) are conductors. Attempts have been made to inhibit the formation of these corrosion products of copper and the other metals, but they have been without success. The shelf-life of copper powder-organic binder mixtures is also poor when compared to that of silver powder-organic medium formulations. Because of these advantages, silver may be used with a high ratio of binder to metal powder; higher than that of any other metal and, hence, conductive silver paints are preferred. Silver powder-organic binder preparations are commercially available, or stable formulations can be formulated in the laboratory. However, the commercially available mixtures are excellent products that have been developed as a result of careful research. The manufacturers of these special paints have shown unusual ability and cooperation in formulating silver conductive paints for unique applications. Paints suited for the various plastic materials can be prepared. Other paints for materials such as wood, leather, cloth, etc., can also be obtained. The metallic silver content usually is adjusted according to the method of application. If it is brushed onto the surface, a paint of at least 50 per cent metallic silver by weight is recommended; for spraying, 35 per cent by weight is suitable while for application by stencil or silk-screen, 60 per cent by weight of metallic silver is employed. Table I shows typical conductive silver paint formulations in use at the present time.

Actually, there are two distinct types of preparations which can be formulated, namely, air-dry or low temperature bake compositions used for materials with reasonable low softening or distortion points (200° F or under, e. g., thermoplastic-type plastics, paper, wood, leather, cloth, etc.) and the fired-on compositions used for ceramics and quartz and glasses with

Fig. 5. Aircraft fuel-gage components with separately plated plastic sections

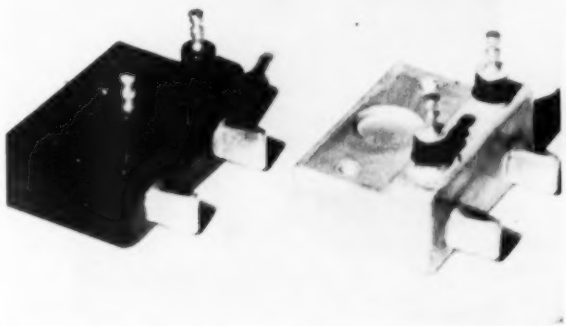

Fig. 6. Phenolic electronic component with metal terminals before and after plating with 0.001 inch silver

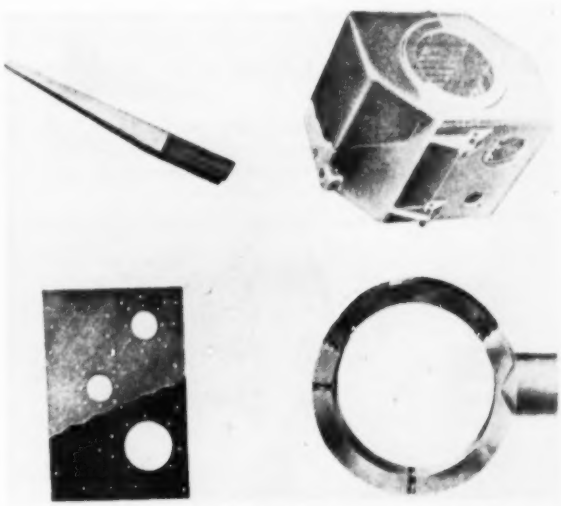

Fig. 7. Examples of plastic electronic parts electroplated for electrostatic shielding. Sections of the electrodeposit were removed for photographic purposes

TABLE I. CONDUCTOR PAINT FORMULAS

(All percentages are by weight)

Base plate material	Ceramics	Glass	Thermosetting type plastics	Thermoplastic type plastics
	* 450° to 800° C	* 450° to 650° C*	* 25° to 175° C	* 25° to 75° C
Pigment	Finely ground silver powder, 65 per cent	Finely ground silver powder, 65 per cent	Finely ground silver powder, 70 per cent	Finely ground silver powder, 70 per cent
Binder	Cellulose resin, 13 per cent, plus. Finely divided low softening point glass, 12 per cent	Cellulose resin, 13 per cent, plus. Finely divided low softening point glass, 12 per cent	Cellulose resin, methacrylate resin, phenolic resins, 20 per cent	Methacrylate resin, polystyrene resin, 20 per cent
Solvent	Acetates or cellosolve derivatives, 10 per cent	Acetates or cellosolve derivatives, 10 per cent	Acetates, ketones or cellosolve derivatives, 10 per cent	Ketones, benzene, toluene or Ethylenedichloride, 10 per cent

* Processing temperature

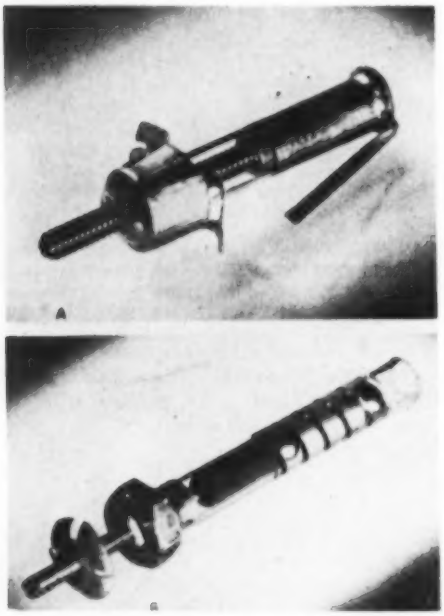

Fig. 8. Solder-plated glass parts. Top, midget trimmer capacitor. Bottom, "Fixed-tuned" or "trimmer" inductance

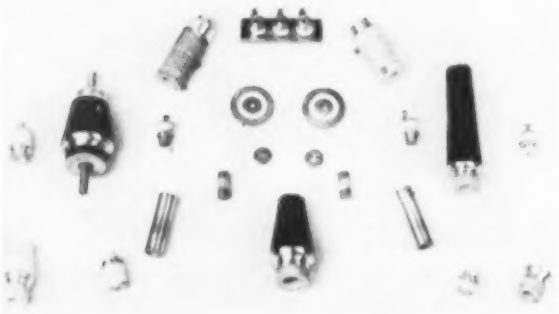

Fig. 9. Examples of selectively plated ceramic parts

high softening points. The air-dry types consist of a binder, thinner and a conductive silver powder, the concentration of which depends on the mode of application as discussed previously. The silver powder is dispersed best into the system by roll milling or ball milling. The fired-on compositions require firing at temperatures ranging from 800° F to 1250° F and are intended for application to ceramic base materials such as porcelain, steatite, titanates and quartz and glass of high softening point. The fired-on compositions are similar to the air-dry or low-temperature bake formulations except that in addition to the silver powder, binder and thinner, a flux which is usually a low melting, finely divided glass, also is incorporated in the system. It is obvious that whenever the base material permits, the use of fired-on type coatings is recommended. The adherence of the fired-on types is far superior to that obtained when the air-dry or even low bake preparations are used. The fired-on types also result in greater conductivity because the silver coating is about 92 per cent silver while the air-dry or low-bake types show a silver coating which is much lower, possibly in the range of 20 to 30 per cent.

Glass

Glass is the base material of many printed circuit components, such as inductances and capacitors of several types. It is characterized generally by good mechanical and electrical properties. Furthermore, glass is hard, nonabsorbent and cannot be deformed permanently. It is much lower in thermal expansion than metals, the Invar types being exceptions, so that dimensional changes are small.

Metal coatings of low resistivity can be formed by firing silver compositions into the glass surface. The result is an adherent coating of silver. Usually, this fired-on silver coating is electroplated with copper and then further plated with tin or lead-tin alloy deposits. In some cases, the electroplated copper is hot tin-dipped to facilitate subsequent soldering. There are

TABLE II. PROCEDURES FOR DEPOSITING METALLIC FILMS

Silver

Method No. 1

Extra fine silver powder	2 parts
Lead borate or sodium borosilicate	1 part

Fire at 600° C

Method No. 2

Powdered flint glass	6 g
Lead oxide	6 g
Potassium nitrate	24
Borax	6
Boric acid	12
Silver chloride	28

Fire at 600° C

Method No. 3

Extra fine silver powder	65 g
Lead borate	3.5
Bismuth subnitrate	1.5
Lavender oil	30

Add 10 per cent barium or lead fluoride

Fire at 600° C

Gold

Gold chloride ($AuCl_3$) is kneaded with enough oil of rosemary to form a paste, after which 5 times as much oil of lavender as oil of rosemary is added. Fire at 900° F

Platinum

Method No. 1

Add 0.2 g of platinic chloride or chloroplatinic acid to 5 cc of alcohol, ethyl ether and 4–5 drops of turpentine. Apply to glass or quartz, preferably roughened. Dry. Heat gently in a Bunsen flame or fire to cherry red in an electric furnace.

Method No. 2

Mix 2 g of litharge, 1 g of lead borate and 10 g of oil of lavender. Add enough platinic chloride to obtain a paste or paint. Apply and fire.

Method No. 3

Prime the glass or quartz with one part of copper sulphate and two parts of ochre. Heat to 250° F. Cool and paint with 50 g platinic chloride, 1 g of litharge and 1 g of lead borate. Fire at 1000° F.

Palladium

6 per cent collodion	3 parts
12 per cent palladium chloride	3 parts
Ethyl alcohol	3 parts
1 per cent bismuth trichloride	1 part

Fire at 500° C to 750° C

Note: Ruthenium, rhodium or iridium can be substituted for the palladium used above.

available special types of fired-on coatings which do not require electroplating but can be soldered to directly.

The composite metal coatings on glass can be produced to accurate dimensions and in a variety of patterns to form circuits, conducting areas, etc., and to which structural parts or terminal leads may be soldered without resorting to complicated and expensive methods. The soldered joints made by utilizing these composite coatings can be vacuum-tight for the purposes of hermetic sealing. Figures. 8 and 9 show glass and ceramic parts which have been solder-plated for the purposes previously outlined.

The bond strength between the metal coating and the glass or ceramic is relatively high considering the difference in properties between a metal and glass or ceramic. Measurements in the order of 2000–2500 pounds per square inch have been obtained. The resistivity of the coating, with only a copper electrodeposit on the fired silver coating, was measured at 1.8×10^{-3} ohms per centimeter cube; the thickness of copper was approximately 0.0005 inch.

While fired-on silver coatings, employing the combination of silver-powder, binder, thinner and flux have found the greatest use in industry today, other methods for obtaining fired metal coatings such as those of gold, platinum and palladium are being used in increasing numbers for special electronic applications. Table II shows some of the best procedures for securing these metallic films.[5]

Before discussing the methods and solutions which are recommended for electroplating the initially formed metal film on plastics, glass or ceramics, it should be pointed out that the basis nonconductive material upon which the conductive film is applied regardless of the method used must be prepared properly to aid adhesion. Roughening the surface by sand-blasting or pumice rolling is recommended wherever possible especially in the case of plastics. Glass, quartz or ceramic surfaces may be prepared by etching with hydrofluoric acid (10 per cent by weight) or sand-blasting. Fired-on metal coatings do not necessitate these roughening treatments as do air-dry coatings, but they are suggested for best results.

TABLE III. SILVER PRE-PLATING SOLUTION FOR AIR-DRY OR LOW TEMPERATURE BAKE COATINGS

Silver nitrate	3–4 av oz/gal
Sodium cyanide	3.5–4 oz/gal
Potassium nitrate	12–14 oz/gal
Water	1 gal
Current density	5–7.5 amp/sq ft
Rod agitation preferred	
Temperature	70°–80° F

Note:

Solution should be filtered after make-up.

Preplate deposit before transfer to conventional bath should be at least .0005 in thick.

TABLE IV. COPPER PRE-PLATING SOLUTIONS FOR AIR-DRY OR LOW TEMPERATURE BAKE COATINGS

No. 1. Copper sulphate	8 oz/gal
Sodium hydroxide	6–7 oz/gal
Rochelle salt	20–22 oz/gal
Water	1 gal
Current density	5–10 amp/sq ft
Temperature	75° F to 80° F
Rod agitation preferred	
Filter solution before using	
No. 2. Copper sulphate	3–4 oz/gal
Rochelle salt	1–2 oz/gal
Triethanolamine	100 cc
Water	1 gal
(Operating conditions as above)	
No. 3. Copper sulphate	2 oz/gal
Sodium oxalate	1–2 oz/gal
Triethanolamine	100 cc
Water	1 gal
(Operating conditions as above)	
No. 4. Proprietary copper pyrophosphate bath	

Electroplating Procedures

As equally important as the proper selection of the type of coating used in making the surface of a nonconductor receptive to electroplating is the type of plating solution used to increase the thickness of the metallized film. This is true whether the conductive metal coating be formed from an air-dry or a fired-on composition, more so in the case of the former. Too often failures, especially with regards to adhesion, result from the employment of conventional plating baths for building up or thickening the initial conductive film. Usually the free acid content, or even more often the free cyanide in the electrolyte, results in chemical attack on the initially applied thin film. The best procedure is to initiate electrodeposition from a specially formulated bath after which the parts are transferred to the conventional plating solution for additional plating. Furthermore, it should be borne in mind that in all cases where electrodeposition is to be employed for adding to the initial coating, it is advisable to electroplate as soon as possible after metallizing. The reason for this is that the conversion of the metallized coating to a metallic oxide or sulfide may cause poor adhesion even though plating takes place. Tables III, IV, V, VI and VII cover the various types of special electroplating solutions for plating initially formed metal coatings of both types—air-dry or low-temperature bake and the fired-on coatings:

Usually a deposit of 0.0005 inch of metal from any of these special plating baths is sufficient to protect the metallized film and enable one to then build up further with metal from the conventional electroplating solution.

In certain applications, the adhesion of the electrodeposited metal to the nonconductor is not important; in fact, in electroforming, to be discussed next, and in electrotyping, the metal layer is separated ultimately from the nonconductive base. However, for the majority of applications, adhesion is very desirable. It is the adhesion of the conductive film initially applied which determines good or poor adhesion. The metal coating must not only adhere to the nonconductive base but also to the electrodeposit which is subsequently applied. Unless this adhesion to both is at a maximum, failures will result. The problem is more difficult in the case of air-dry or low-temperature bake coatings than with the fired-on type coatings. If failure in adhesion does result due to tension or shearing, it should be within at least one of the layers—the nonconductive base upon which metal is applied or in the electrodeposit itself not in the intermediate layer, that is, the conductive coating.

Because of the great difference in the chemical properties of metals and nonmetals, there is really no atomic binding between the two dissimilar materials. For this reason, roughening the surface, after its proper cleaning, is used widely to increase surface area and to provide mechanical interlocking. It is actually the difference in coefficients of expansion of metals and nonconductors which is the cause of poor adhesion. Thin electrodeposits, up to 0.001 inch in magnitude, show better adhesion since the metal expands and contracts with the plastic, glass or ceramic at practically the same rate with changes in temperature. However, thicknesses greater than 0.001 inch show less adhesion. Thicknesses from 0.001 inch to 0.003 inch show the poorest adhesion; beyond 0.003 inch the adhesion improves because of other factors which enter the over-all picture. Glass and ceramics possess coefficients of expansion which approach those of most metals. The phenol-formaldehyde type plastics represent the only group which approach metals in values for coefficients of expansion.

TABLE V. PRE-PLATING SOLUTIONS FOR FIRED-ON COATINGS

Silver

Conventional silver baths may be used for direct silver deposition upon the coating.

Copper

Conventional acid copper baths may be used for direct copper deposition upon the coating.

Copper fluoborate bath can also be used.

Slush Molds

The employment of metallized nonconductors in the electroforming of wave-guides (so-called "radar-plumbing"), in electrotyping, and in the phonograph record industry is covered rather extensively in the literature and will not be discussed in this paper. Two phases of electroforming which are not as well known but equally as important are the manufacture of slush molds and spray masks (stencils).

The slush molding of organic plastisols, particularly those of the soft vinyl type, offers many advantages. By this process, molded articles can be produced in both small or large quantities with minimum mold cost and maximum process flexibility. The molds can be made rapidly; and, if the originally designed products must be changed at a future date, changes can be made quickly and economically with the new molds put into production in a short time. Slush molding is an excellent method for producing such items as boots, rubbers, manikin parts, rattles, doll-heads, arms and bodies, toys, fishing-lures and numerous other articles. The method to be described also is adapted to the formation of inexpensive injection molding cavities. It is adapted especially for the production of deep, narrow cavities which can be built up in one piece on an accurate mandrel. It is ideal for any low-pressure molding. In slush molding, no pressure whatsoever is used in the process.

Electroplating has become an important part of this slush molding process since working molds can be produced by the electrodeposition of copper in 3 to 5 days depending on the size of the part at reasonably low costs. For small objects, the wall thickness of the electroformed mold is about 0.075 inch to 0.100 inch; for large objects a wall thickness of approximately 0.125 inch to 0.150 inch is desirable.

It is beyond the scope of this paper to discuss the steps in the manufacture of slush molds such as the formation of the plaster of paris and wax casting of the part to be reproduced. Suffice to say, it is the smoothened and polished wax casting made from the plaster mold which is used for the subsequent build-up of metal. In some cases, the actual plastic pieces from previously finished molds also are used to produce additional molds and thus speed up the slush mold making process.

While the initial conductive film can be applied by using the conductive paint or vacuum deposition method, the chemical reduction process, involving the reduction of ammoniacal silver nitrate with formaldehyde is best. Sensitization with stannous chloride or a similar treatment is necessary. The main purpose for using the chemical reduction method is the more exact duplication of the fine detail in the wax casting than can be obtained with conductive paints. The high-vacuum method is objectionable because of the high cost of equipment and the outgassing of the wax casting which prevents rapid pump-down cycles.

Since adhesion is not a problem in this application, the build-up with copper can be from the conventional acid copper bath or the copper fluoborate solution without use of any of the previously described special preplating solutions. Plating takes place for 3 to 5 days depending upon the size of the mold and the thickness required. Current densities starting at 5 asf with a gradual increase to 100 asf are used. It is essential that temperature-control, constant filtration, rod-agitation and bagging of the anodes or anode compartments be used in this plating operation. Wherever possible, "thieves" or "robbers" should be utilized at high-current density points for uniformity of deposits. In fact, the principles of racking for hard-chromium plating should be adapted as much as possible to heavy-copper electrodeposits.

Metal spraying for heavy build-up of metal has been used successfully; but, while this process is much faster than electroplating, it is a question as to whether it is cheaper considering the over-all picture. The metal layer obtained is definitely not as homogeneous as electrodeposited layers, not as dense and not as hard.

Molds may be built up with nickel in lieu of copper. The nickel sulfamate bath is recommended.

After formation of the thick-copper shell, it is good procedure to hard-chromium plate the inside surfaces

TABLE VI. NICKEL PRE-PLATING SOLUTIONS FOR AIR-DRY OR LOW TEMPERATURE BAKE COATINGS

No. 1.	Nickel sulphate	10 oz/gal
	Ammonium chloride	8–8.5 oz/gal
	Water	1 gal
No. 2.	Nickel sulphate	12–14 oz/gal
	Boric acid	1–2 oz/gal
	Water	1 gal
	Operate either bath at room temperature and at a current density of 5–10 amp/sq ft	
	Deposit .0005 in. thickness of nickel prior to transfer to conventional nickel baths	
No. 3.	Nickel sulphate	10 oz/gal
	Ammonium chloride	2 oz/gal
	Boric acid	2 oz/gal
	Sodium sulphate	20 oz/gal
	Water	1 gal
	Temperature	100°–110° F
	Current density	10–15 amp/sq ft

TABLE VII. NICKEL PRE-PLATING SOLUTION FOR FIRED-ON COATINGS

Conventional nickel baths may be used but the best results have been obtained with the following bath:

No. 1.	Nickel sulfamate	40 oz/gal
	Boric acid	3 oz/gal
	Small addition of anti-pit agents	
	Temperature	95° F–100° F
	Current density	60–75 amp/sq ft

Note:
Proprietary nickel sulfamate bath commercially available.

No. 2.	Nickel sulphate	20 oz/gal
	Nickel chloride	3 oz/gal
	Boric acid	2 oz/gal
	Magnesium sulphate	2 oz/gal
	Temperature	110°–115° F
	*p*H	5.2 electrometric
	Current density	15–20 amp/sq ft

Fig. 10. Typical electroformed slush mold

of the slush mold for both wear and ease of removal of the molded article. However, because of the intricacies of a slush mold, expensive and tedious anode fixtures are necessary for application of hard chromium to the vital surfaces of the mold. For that reason, application of "electroless nickel" is recommended especially for molds electroformed in any metal but nickel. Since nickel will coat all interior surfaces regardless of their shape easily, no special anode assemblies are necessary. It is true that the wearability of the nickel is not as good as that of chromium; but, surprisingly, in practice the molds have operated for long periods of time. In fact, it is a simple matter to apply more nickel when certain areas reveal the basis metal. No stripping of the remaining nickel is necessary. Application of electroless nickel over previous coatings reveals no peeling whatsoever. Fig. 10 shows a copper slush mold which was nickel plated on the interior or working surface with electroless nickel. In spite of its complicated inner shape, every part of the mold in contact with the electroless nickel bath will receive a coating of nickel. Our experience reveals that nickel coatings in the order of 0.0001 inch to 0.0002 inch thickness are sufficient.

Regarding the electroless nickel bath for this purpose, the various commercial processes available have sufficed as has the original National Bureau of Standards bath.[6,7] This author prefers, however, the following bath which is similar to that described by H. J. West:[8]

Nickel chloride	6–8 oz/gal
Sodium hypophosphite	1–1½ oz/gal
Sodium citrate	1–1½ oz/gal
Water	1 gal
Temperature	195°–200° F
Treatment	15–20 min
Thickness of nickel applied	0.0001–0.0002 inch
Life of bath	8–12 hrs.
Glass tank for bath	
*p*H	3.5–4.0 (adjusted with 0.25 per cent sodium hydroxide)

When the slush mold is electroformed in copper, the entire form is cleaned thoroughly and bright-dipped in the conventional nitric-sulfuric acid bright dip. After thorough rinsing and neutralization, in a mild alkaline solution, it is dipped for 30 seconds in a palladium dip made up as follows:

0.02 g/l of palladium chloride
20 ml/l of hydrochloric acid

Following the palladium dip, the part is ready for the deposition of electroless nickel.

Spray-Masks

The selective decorating of molded plastic products with various colored lacquers or enamels for the purpose of further enhancing the salability of these articles has presented certain problems. Application of these organic coatings by means of hand-painting, for example, requires skilled artistry on the part of the operator and is a costly time-consuming operation. Fortunately, the use of a suitable mask or stencil made by electroforming used in conjunction with spray equipment with accessory jigs and fixtures, has resulted in an appreciable lowering of costs and today is the procedure which has all but eliminated hand-painting operations. As in the production of slush molds, the fabrication of a suitable mask using the metal spray gun for producing the proper shell from which the mask is cut, has proven satisfactory in certain cases, especially where speed is essential, but in the majority of cases has proven inadequate. Recently, other methods have been devised for the fabrication of masks but electroplating is still regarded as the most efficient method for producing metallic reproductions to be used ultimately for making masks or stencils.

The procedure is simply as follows: the exact item to be sprayed selectively is attached by cementing at its parting line (if one exists) to a sheet of plastic; the entire form is made conductive using the conductive paint method (air-dry or low-temperature bake coatings are suitable); the entire form is electroplated with copper deposited from the conventional acid-copper bath or the copper-fluoborate bath or with nickel from the nickel-sulfamate bath (a thickness of 0.050 inch to 0.060 inch of metal is applied). When sufficient plating is obtained, the edges of the flat sheet are cut away at the extremity by using a jigsaw or similar tool and then, with the application of an acetylene torch played over the entire surface, the metal shell is separated. The metal shell is an exact reproduction of the plastic part and, hence, the molded parts from the same plastic mold cavity will fit into the shell exactly. Plastic molded items from other cavities in the same mold, but which may vary even slightly from the one

used to make the mask, will necessitate the manufacture of additional masks to handle moldings properly from each cavity. Shrinkage and distortion in the plastic molding will cause difficulties in spraying and should be watched closely.

Those sections of the plastic part which subsequently are to be spray painted are cut out of the metal shell skillfully. After attaching any special reinforcements to the shell and properly mounting, it is ready for hard chromium plating or, in the case of masks other than nickel, it is "electroless" nickel plated. It is beyond the scope of this paper to discuss the various special types of spray masks or stencils such as the "bridge," "block" and "unblocked" types, the use of "baffles," etc. Suffice to say, electroforming is the important part of the manufacture of all. Fig. 11 shows several types of stencils of the type in use at the present time.

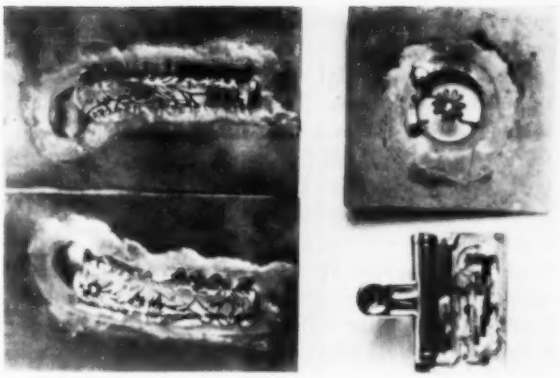

Fig. 11. Typical spraying-masks made by electroforming

Electroforming in Medicine and Dentistry

As revealed in an excellent article which appeared in Plating a few years ago,[9] the dental profession has been using electroforming techniques to great advantage for over half a century. Through the use of these methods, the quality of the service rendered has improved markedly. New electroplating techniques are being developed in the dental laboratories which will further prove the importance of the electroplating industry.

In the dental profession, electroforming provides the accuracy necessary for making dental crowns and certain types of inlays. Actually, the process involves the formation of an electroformed copper shell from an impression made from the tooth.

With regards to the medical field, the author was presented recently a most unusual project involving the metallization of plastics. A surgeon in charge of the chest section of a famous clinic developed a technic of injecting polyvinyl chloride into the air-channels of the lung.[10] After the organic material had set or hardened, the tissue was dissolved away with an acid, leaving a plastic cast replica of the air-space in the lung. The purpose of the development was to use the replica for teaching purposes especially in X-ray. The cast, which, in shape, resembled the roots of a small bush, was extremely fragile. It was suggested that this plastic cast or replica be plated with copper to a sufficient thickness to allow it to be handled without breaking or at least to increase its strength so that it was not broken so easily.

The production of artificial limbs by electroforming methods is another important advance made by the electroplating industry in the field of medicine.

Conclusion

It is hoped that the foregoing has brought to light numerous industrial applications for electroplating which are entirely different from the more familiar plating operations carried out for the purpose of increasing corrosion and wear resistance or for decoration. The various applications for metallized nonconductors discussed in this paper are the most important ones being used today. Time did not allow discussion of many others, which may become equally as important. New applications are on the horizon and only time will reveal the position of the plating industry in these developments. Based upon past performances, it is safe to predict that the electroplater, using his electrochemical knowledge and ingenuity, will be an important cog in that wheel of progress.

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DISCUSSION

Mr. Arthur Logozzo (Nutmeg Chrome Corp., West Hartford, Conn.): I would like to ask Harold how you remove the metallized plastic cylinder shown in the second slide by mechanical means—without impairing the seal or adhesion?

Dr. Narcus: It can be done with an ordinary lathe, using a lathe tool to remove the outer skin, or a grinding wheel may be used. Naturally the groove being slightly recessed from the surface of the metal there will be metal remaining in those grooves; you are removing only the surface metal.

Mr. Logozzo: Evidently adhesion is no problem.

Dr. Narcus: Not if the tool is properly dressed and used properly.

Mr. Logozzo: You also showed a slide with some polystyrene parts metallized and plated and then selectively stripped for photographic purposes. I wonder if you will take a moment to go step by step

on the plating procedure for polystyrene. Then describe selective stripping.

DR. NARCUS: I did not give the exact prodecure of plating polystyrene. The part to which you referred is undoubtedly the loop antenna. The usual procedure in plating that part is to first depolish or roughen the part, using an abrasive blast with 220 grain aluminum oxide. Following blasting of the part, it is cleaned in a mild alkaline cleaner. It is then sensitized in innumerable ways. One very successful way makes use of stannous chloride sensitization. Following the sensitization, a silver film is deposited on the plastic surface using ammoniacal silver nitrate reduced with formaldehyde and there again innumerable formulations are available for depositing the silver film on the plastic. After the silver film has been thoroughly dried either over night or by forced air drying it is then electroplated with copper, in this instance 0.001 inch of acid copper was used. Finally the part was cadmium plated. If I remember correctly about 0.001 inch of cadmium was used.

Regarding Mr. Logozzo's other comment, how was the section removed for photographic purposes, that was the easiest thing in the world to do—all one has to do is get a good, sharp jack knife, cut around a certain section, then another and with plenty of pull one can pry the metal off.

DR. MARVIN RUBINSTEIN (New York): This is not a question but a comment. You stressed chiefly the manufacture of slush molds because that is a process being used extensively in this country. I would like to point out that recently I visited a plant in England where they are making extremely accurate stress free injection molds from nickel. They usually deposit from $\frac{1}{8}$ to $\frac{1}{4}$ inch of nickel followed by anywhere from $\frac{1}{4}$ to 1 inch of copper. They manufacture excellent injection molds. These are being used extensively by plastic and rubber industries there.

Another comment with regard to the plating on plastics, the photographic process for manufacture of fine screens is being used both here and abroad to obtain practically any thickness or mesh desired.

MR. ARTHUR W. JOHNSON (Empire Brass Mfg. Co., London, Ontario): Can you give me some information as regards comparable price regarding plating on plastics and zinc die cast parts.

DR. NARCUS: The question is, could a comparison be made between the plating of a certain plastic part and the plating of a die casting part similar in shape?

MR. JOHNSON: Yes, taking into consideration the cost of buffing, etc.

DR. NARCUS: Yes, that question has been asked me over the years innumerable times. Assuming that the plastic part could be made very, very cheaply by injection molding or compression molding, the cost of plating a plastic part and plating a similar part made in zinc base die casting, for example, would be approximately 10 percent more.

MR. JOHNSON: On the plastic?

DR. NARCUS: In the case of plating on the plastic part, that has been checked very thoroughly. The only time when the comparison would be identical would be if the part could be injection molded or compression molded on mass production, extremely cheaply. Then you may bring the difference in price closer together. Does that answer your question? That is, of course, assuming that we are plating each part with the same method, for example, copper nickel chromium.

MR. JOHNSON: That is the assumption.

MR. EDWARD HERZIG (Electro Tech. Corp. South Hackensack, N. J.): In plating on plastics, would you not have trouble with absorption of solution by the plastic?

DR. NARCUS: There is a certain amount of absorption of the plating solution during the solution of processing of a plastic, but in the case of complete envelopment of the plastic part, we have not seen any ill effects. In the case of selectively plating of a plastic part, we again have not seen tremendous changes in the characteristics of a plastic. For example, the color of a plastic is noticeable when it is selectively plated and we have never noticed any discoloration of the plastic. There is no doubt that there is some absorption of the plating solutions, but in answer to your specific question, while there may be some absorption in the case of cellulose acetate or cellulose butyrate we have not been disturbed by such absorption. Of course in the case of polystyrene absorption is practically nil. In the case of phenolics, such as phenol formaldehyde or urea formaldehyde compression molding types, we don't feel that the absorption would be serious,

MR. STANLEY J. KLIMA (Sperry Gyroscope Company, Great Neck, L.I., N. Y.): In reference to silver paint, the air dried type, what effect has particle size and shape of the silver powder in silver paint on the electrical conductivity of a coating on plastics?

DR. NARCUS: The particle size is probably the most important factor and must be kept as low as mechanically possible.

MR. KLIMA: What sort of shape?

DR. NARCUS: Flat.

MR. KLIMA: About what mesh size would you say would be the most ideal?

DR. NARCUS: That is a tough one. In answer to that question, I would rather not give other than a hazardous guess at the mesh size. I would say you should approach 0.001 inch mesh but again I am not certain of that. It is in that order, but it should be a flat structure and it is a most important matter in the formulation of silver paints. That is one of the reasons why I said, during the course of the paper, that commercially available silver compositions can be obtained. For those of you who are entering into this phase of electroplating for the first time I would definitely start off using commercial compositions because all companies in this field of silver paint formulations have spent years and years of research in the field and you can feel confident that they can supply any special or particular paint for your application.

MODERN INDUSTRIAL PAINT STRIPPERS*

RUBIN M. OPEROWSKY†

General Considerations

Today, as never before in the history of American industry, industrial paint stripping has become a major operation in the manufacturing and job finishing plants. The need for economy and speed has necessitated the replacement of the older, slower, and more costly mechanical methods, such as sandblasting, scraping, buffing and burning off, in favor of the more economical, efficient and more rapid chemical paint strippers.

The organic coatings of today have advanced far in complexity from the days of the simple drying oil paints. We are now living in the polymer age, where terms such as "alkyds, vinyls, phenolics, ureas and melamines" are household words. Although these terms are widely used, the knowledge of their chemical compositions and formulations are not so well known outside of the paint laboratory.

Table I shows the chemical formulas of the most widely used resins in organic coatings.

The formulation of paint strippers would be relatively simple if only one resin were to be used in the making of an organic coating. However, this is seldom the case. By blending a number of resins, paint chemists have been able to combine the desired chemical and physical properties of an individual resin with that of others, and tailor-make a coating to fit any desired set of conditions. Although this copolymerization is industrially desirable, it is one of the chief sources of difficulty to the formulators of paint strippers.

A good example of this can be seen in the difference in stripping between an alkyd and styrenated alkyd in the government specification MIL 10687. Alkyds are readily stripped by alkali, cold strippers and hot emulsion strippers, while styrenes are soluble in practically all types of solvents. However, the styrenated alkyd can not be stripped by any of these media. Considerable work was necessary before a satisfactory stripper was developed for this paint.

There are factors other than the coating formulations that play an important part in determining the effectiveness of the paint remover. They are as follows:

1. The pigment content and pigment density of coating
2. Condition of the metal
3. Primers
4. Continuity and thickness of the paint film
5. The degree of polymerization.

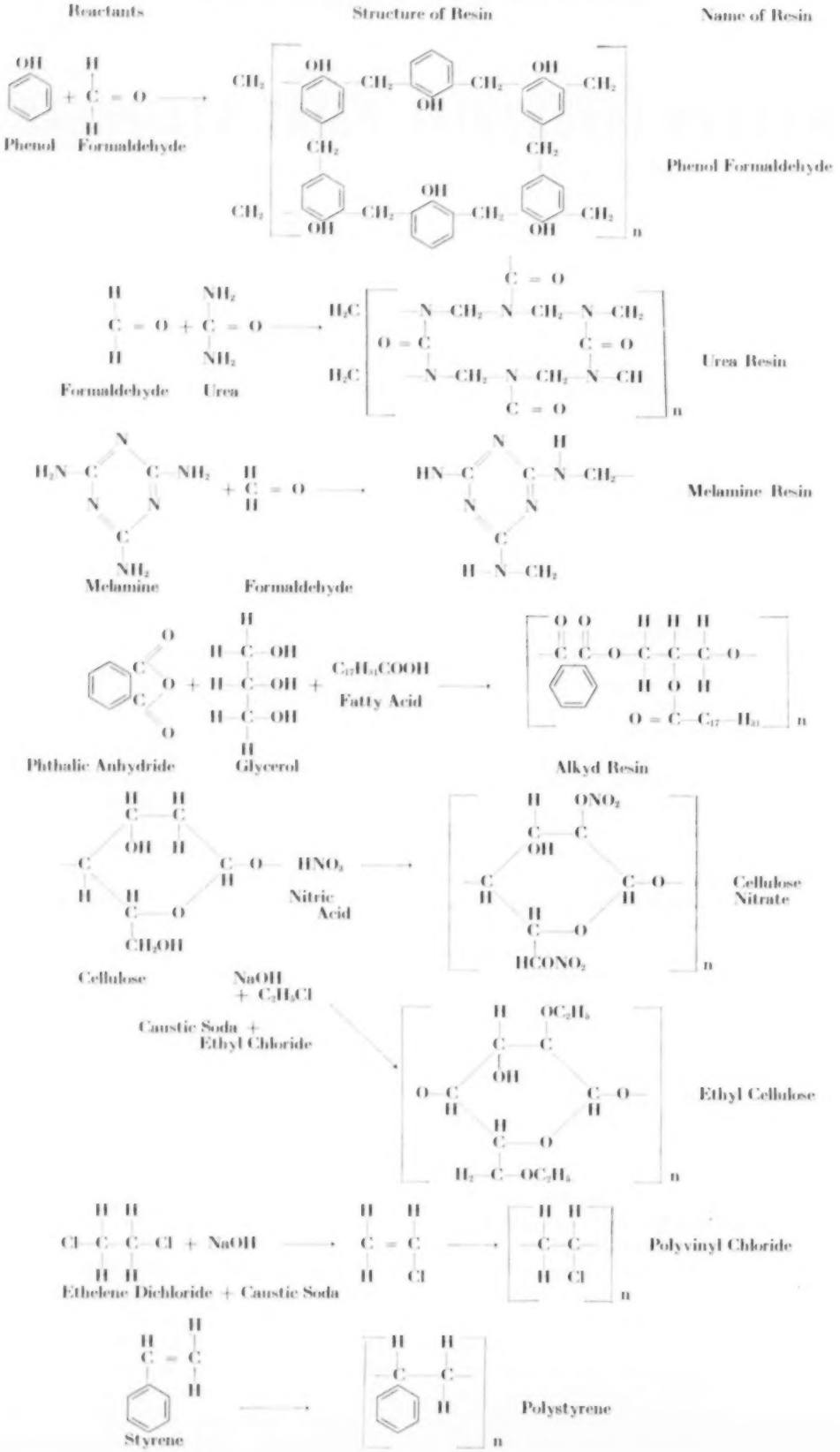
Since alkali and acid strippers and thinners primarily are dependent upon their solvent action, the aforementioned factors do not affect the operation of these materials to any great extent. The effect upon the efficiency of the hot and cold solvent based strippers is more pronounced and merits further consideration.

The condition of metal surface is a vital factor affecting paint adhesion—the greater the surface, the better the adhesion of the coating. The increased area resulting from sandblasting, etched surface, porous castings and from conversion coatings have added to the difficulty of paint removal. Not only do these conversion coatings increase the surface area of the metal, but the porous nature of the inorganic film enables the paint to penetrate into the crevices and form a deep-rooted and firmly bound bond with the surface. The increased surface and the penetration of the paint into the porous inorganic film retards the stripping operation. Using the same paint and the same stripper, the coating on an untreated surface will wrinkle and lift away rapidly in large sheets. On the other hand, the stripping time of the piece having a conversion coating is greatly increased, and the appearance of the stripped paint coat is considerably altered. Instead of the customary large sheets of paint and a clean surface, the coatings from phosphated, chromatized or anodized work, break away in small uneven pieces, leaving much of the paint coat still clinging to the metal.

The use of primers is another method employed to retard corrosion and increase the adhesion of the final organic film. Red lead, iron oxide and zinc chromate

*Presented at the Forty-first Annual Convention of the American Electroplaters' Society, July 12, 1954.
†Chief Chemist, Chemclean Products Corp., Bronx, N. Y.

TABLE 1. RESINS USED FOR ORGANIC COATINGS



are the primers most widely used. Formulations for metal finishing generally have a high pigment to vehicle ratio. Because of this, the resulting films are generally thin and porous. From observations in the laboratory of the author, it is believed that there exists a direct relationship between the effectiveness of the stripper and the thickness and the porosity of the film. There appears to be an optimum thickness at which the stripping time is a minimum and the efficiency of the stripper is a maximum. As the thickness of the coating increases or decreases beyond that range, the time of removal increases and the effectiveness of the stripper decreases. The mechanism by which the strippers function is dependent upon an ability to penetrate through the coating and break the bond between the continuous film and the metal. Hence, as the porosity of the film increases and the continuity of the film decreases, the effectiveness of the stripper will decrease. A recent problem that was encountered illustrates this point clearly. An instrument dial was coated a zinc chromate primer, after which only one side was finished with a final second coat of paint. In the stripper, the side with the two coats stripped cleanly in a few minutes, whereas the side with only the primer showed no effect other than a softening action after a few hours of immersion. To check the results, different strippers were tried and the results were the same with regard to the primer.

Removal of a film of oversprayed paint is another variation of stripping of a porous film. The section with the continuous film will strip cleanly, whereas the section containing the overspray will show some signs of wrinkling where the film is slightly heavier, but as a rule it remains intact with only some signs of softening.

Heavily pigmented coatings affect the efficiency of the stripper. The high pigment content plus the density of the pigment retard the solvent stripper from penetrating through the coating to the base metal to break the bond between the metal and the coating. Such coatings are usually found on refrigerators, washing machines, etc., where high chemical and moisture resistance are desirable. The stripping time for these coatings is considerably greater than a coating coning the same resin with a lower pigment content.

Improper baking is another vital factor affecting the successful operation of a stripper. Overbaking results in overpolymerization, and is much more difficult to strip. On the other hand, underbaking results in incomplete polymerization. The uncured coatings are more susceptible to chemical attack and are readily softened at elevated temperatures. Generally, cold strippers dissolve the unpolymerized resin, whereas the fully polymerized coat only blisters and wrinkles. Hot solvent emulsion strippers succeed only in softening the unpolymerized coating. When an inadequate sampling of pieces is taken, the improperly cured part can be a misleading factor in the selection of a proper stripper because practically all unpolymerized coatings are soluble to an extent in thinners and alkali, whereas the correctly cured polymer may be totally unresponsive to these media.

Types of Strippers

There are five different types of materials that are used for industrial paint removal. Of these, alkali, acid strippers and thinners act as solvents for the paint film, while cold strippers and the hot emulsion strippers wrinkle and lift the coating from the metal. Since stripping is primarily a salvage operation, the choice of type of materials used must be the one, which, under existing conditions, gives the best performance at a minimum of cost and handling. Other factors influencing the choice of type of paint stripper are:

1. Allowable time per unit operation
2. Availability of equipment such as tanks, rinses, spray washers, current, heating facilities, adequacy of ventilation.
3. Odor, inflammability and health hazard involved in the use of a particular type of material.

Alkaline Strippers

The alkaline based strippers are most widely used in industry today. These formulations are based chiefly on caustic soda and caustic potash plus the addition of a suitable surfactant to improve the wetting, penetration and rinseability. However, these materials are not restricted to caustic soda and caustic potash alone, but may also contain other alkaline salts, such as soda ash, tri-sodium phosphate and more alkaline silicates.

The alkaline stripper may act upon the coating in two ways:

1. Attack upon the pigment
2. The disintegration of the organic resin.

The disintegration of the resin is dependent upon the ability of the stripper to saponify the fatty acid portions of the vehicle, as in alkyds, or upon the ability of alkali to break up ester linkages, as in the case of cellulose nitrate. Alkyds, phenolics, oil paints, gum, varnishes, cellulose acetate and cellulose nitrate can be stripped in an alkaline bath while vinyls, ethyl cellulose, ureas, melamines and epoxy resins remain unaffected.

The chief advantage of alkaline type material lies in its relative cheapness and ease of application. Such compositions can be used in spray washers, with current as an electro-stripper, or in the conventional manner in soak baths. Even though spray and electro-stripping are faster, and leave a cleaner surface at lower concentrations, they are not used to any great extent. This can be attributed to the general lack of sufficient equipment and space. Soak baths are used as hot as possible at a concentration of between 8 to 16 ounces of stripper per gallon of water. An ordinary gas or steam heated steel tank can be used, and since the alkali is practically odorless, special ventilating systems are not required.

Strongly alkaline stripping baths will tarnish brass and etch zinc and aluminum and, consequently, the use of these materials is limited to stripping coatings from iron, steel, copper and magnesium. Nevertheless, coatings have been stripped from aluminum without etching or pitting by the use of inhibited alkaline strippers. Care should be taken when stripping a coating from a phosphated steel piece with alkali, since it is believed that over-exposure of a phosphate coating to a strong alkaline bath will be detrimental to the phosphate coating.

Since the action of alkali is basically that of solvation, there is a strong tendency for these materials to dissolve the organic portion of the coating and leave the pigment clinging to the metal. Extra operations must be used to remove these smuts. Rinsing in stagnant and running water rinse tanks does not remove much of the pigment. Spray rinsing has proven more effective. Where water rinsing is ineffective in any one of its forms, other methods such as removal of acid soluble pigments in an inhibited pickling acid, or the tumbling of small pieces in a sawdust barrel have proven more successful. Where these methods are unsuccessful or facilities are limited, hand brushing must be resorted to. Alkaline strippers are slower acting than the other types of materials, the time being dependent upon the type of resin and the degree of polymerization. Their speed, however, can be increased by increasing the concentration of the bath within limits and addition of a suitable synergist. Addition agents of this nature are generally based on cresylic acid, phenolic derivatives and other newer cyclic organic compounds.

Acid Strippers

Anhydrous concentrated sulfuric acid is one of the most effective and economical stripping materials. It has the advantages of being fast acting, leaving clean surfaces, and dissolving coatings without attacking the base metal. Regardless of the advantages of price and performance, neither concentrated sulfuric acid nor any of the strong mineral acids are used for stripping on any large scale. One drawback to the use of concentrated sulfuric acid is its corrosive nature, which makes it a serious health hazard when used in production. Secondly, concentrated sulfuric acid tends to absorb moisture from the atmosphere. The hydrated acid is corrosive to the metal, and not only attacks the organic coating, but will also leave its mark on metal surface.

The action of acid strippers in the removal of an organic film may depend upon three factors:

1. Oxidation or esterification of the resin
2. Solvation of the pigment
3. Attack of the acids upon the base metal, breaking the bond between the coating and the metal

These formulations are generally based on solutions of strong oxidizing agents for the oxidation of unsaturated linkages, esterifying acids and as materials useful in inhibiting the attack upon the base metal. Since metals are highly sensitive to acid solutions, this type of material must be properly balanced to give the greatest effectiveness and a minimum of surface attack. Although acids can be used on many metals, the greatest measure of success has been attained in the removal of tenacious organic films from aluminum without etching or destroying the finish. However, at best, acid strippers are used only for special limited applications.

Thinners

Lacquer thinners, although not generally classed as paint strippers, are the cheapest form of organic paint remover available. Thinners are a blend of three different classes of solvents:

1. Active solvents—esters and ketones such as ethyl acetate, butyl acetate, acetone, methyl ethyl ketone, etc.
2. Latent solvents—alcohols such as methanol, ethanol, butanol.
3. Diluents—hydrocarbons, such as benzol, toluol, naphtha and mineral spirits.

The use of thinners in paint removal is limited to a few applications. The removal of defective coatings prior to baking, and the stripping of some air dried paints and lacquers. Vinyls, cellulose acetate, cellulose nitrate, ethyl cellulose and drying oil paints are soluble in thinners, whereas most baked synthetic coatings are completely unaffected by them.

Factors other than the lack of versatility limiting the use of thinners as industrial paint removers are:

Low flash point
High degree of inflammability
High rate of evaporation
Pungent odor
Toxicity of the vapor

These factors make thinners a serious health and fire hazard in the shop. Although the price per gallon is less than that of other organic solvent type strippers, in the long run it is much more expensive.

The life of thinners is limited to the per cent of active solvent in the formulation, and as the resin content builds up, it reaches a saturation point. Then the solution is more apt to function as a paint than as a paint remover.

Cold Strippers

The cold strippers, although the most expensive stripping baths, enjoy the greatest popularity. They possess the following desirable properties:

1. Rapidity of action;
2. High flash point;
3. Low inflammability;
4. Minimum of corrosion;
5. Work is left clean and ready for refinishing.

Cold strippers are generally a blend of chlorinated solvents, methylene chloride or ethylene dichloride, methanol, ammonia or acetic or formic acid, and any number of additional solvents that may be needed for any particular coating.

As far as is known, nothing has been published in the literature explaining the mechanism of reaction between strippers and organic coatings. However, on the basis of work on strippers in our laboratory; we have formed our own theory with regard to their action. We believe in order for a solvent to function as a stripper it is believed that the material cannot be a true solvent for the polymerized resin, but it can only serve to swell the film and act as a jelling agent. When a painted panel is inserted into the stripper, the coating is swelled to a small extent and the solvent is absorbed into the coating. After the solvent is absorbed, it diffuses through the coating to the base metal. When enough solvent has penetrated to the metal, a sufficient pressure is built up to break the bond holding the paint to the surface. In cases where a greater bond exists, as in the case of phosphated or anodized pieces, a greater pressure must be exerted by the stripper. When sufficient pressure is not built up, the stripper may fail completely, or do only a partial job. This can be overcome in some cases, by increasing the viscosity of the stripper by addition of a film forming material. This new film formed on top of the coating, causes the pressure exerted by the stripper to be exerted in one direction only without losses due to outward diffusion.

Since the speed of a stripper is dependent upon the ability of the ingredient to diffuse through the coating, it is to be expected that the smaller the molecule, the faster the stripper will operate. This was proven conclusively by experiments carried out by Keuntzel and Liger,[3] using different chlorinated solvents of varying chain lengths and configurations, methylene chloride, the smallest molecule, acted at least twice as fast as ethylene dichloride, the next larger chlorinated solvent. This is not limited to chlorinated solvents, but also holds true for strippers based on ketones, nitrogen bearing compounds or any other materials with stripping properties. The smaller the molecule, the faster the stripping. Accelerators, such as ammonia, acetic or formic acid, seem to function as pure openers for the solvents, to provide some needed acidity or alkalinity, to neutralize electrostatic forces at the surface, and to provide a microscopic surface attack upon the metal. It has also been proved that the addition of methanol speeds up the action of chlorinated solvents. It is believed that it serves to increase the polarity of the solvents by means of hydrogen bonding. Since coatings used industrially today are a blend of different resins, cold strippers contain a number of other active solvents (in addition to those discussed previously) to facilitate more active stripping. The efficiency of a number of chlorinated solvents are shown in Table II.

Although cold strippers have many desirable properties, are easy to operate and need not additional equipment, they also have their drawbacks. Being composed of volatile, organic solvents, they should never be used in a confined area without adequate ventilation. On the other hand, the greater the ventilation, the greater the evaporation. Numerous methods have been experimented with to reduce these losses, but none have proven completely satisfactory. Some people prefer the use of a nonmiscible water layer with salts added to increase the surface tension, such as a 1 per cent sodium chromate solution to act as a seal. Others use deep tanks with a minimum of exposed area, while some manufacturers include waxes and resins, such as cellulose acetate or ethyl cellulose to retard evaporation.

TABLE II. EFFICIENCY OF CHLORINATED SOLVENTS IN STANDARD PAINT REMOVAL

Solvent	Stripping time in minutes
Methylene chloride	4.5
Ethylene dichloride	9.4
Trichlorethylene	12.4
Monochlorbenzene	12.5
Carbon tetrachloride	18.8
Orthodichlorbenzene	20.4
Propylene dichloride	29.1
1, 2, 4, Trichlorbenzene	16.2

Hot Solvent Emulsion Strippers

Hot solvent emulsion strippers, based primarily upon phenol or phenolic derivatives and a suitable emulsifier, have been found most advantageous in the stripping of alkyd, melamine, phenolic, epoxy and urea type coatings. They are especially practicable for large production stripping where speed and efficiency are vital to make the stripping operation economically feasible. On a dollar to dollar basis, a much greater value is gotten from the hot emulsion stripper than from any other type of stripper on the market today.

When used as a soak, the emulsion generally contains 3 parts of water to 1 part of stripping concentrate. In a spray stripping operation the concentrate can be diluted 10 to 1. When used as directed by the manufacturer at the proper temperature and in a steam heated tank, there is little fire hazard and the loss due to evaporation is small. The *p*H of these materials is such that coatings can be stripped from zinc, aluminum and brass without attacking the metal.

Serious drawbacks to the use of the phenolic hot emulsion stripper are its characteristically disagreeable odor and the health hazard when used in a confined area without proper ventilation. Gloves should always be worn when working with these materials. Most organic solvents only irritate the skin due to a defatting action, but phenol and its derivatives can cause severe burns when brought into contact with the skin. A less serious drawback is that most emulsion strippers, especially after being overheated, leave films on the metal. These films can be readily removed in a mild alkaline cleaner.

The action of the phenols in the hot stripper is

analogous to that of the chlorinated solvents in the cold stripper. The phenols act as partial solvents and in combination with the heat of the bath act to swell the coating. The emulsifying agent wets the surface and enables the phenols to penetrate through the resin to the base metal. As in the case of the cold stripper, a wedge is formed between the metal and the coating until enough pressure is built up to break the existing bond between the organic film and the metal. When this takes place, the coating lifts away cleanly in large sheets.

Stripping Coatings From Plastics

The increased use of molded plastic products has created a new industrial stripping problem. This is the removal of a polymerized film from another organic polymer without softening, attacking or distorting the base plastic. Since such base plastics are more sensitive to heat and attack by chemicals than are the metals, different techniques and materials must be used in removing coatings from them.

The coatings used on plastics are of the air-dry variety. Since both materials are soluble in many of the same solvents, the only method that can be used to remove these paint films from the base plastics is that of differential solubilities. This necessitates extensive research because each problem may be entirely different. Removing a paint film from a plastic base is much slower and a more costlier process than stripping paint from metal, but on the other hand, it is much cheaper than grinding and remolding the plastic. The solvents for this type of paint removal would be of no economic value if used for paint stripping from a metal surface.

Conclusion

Each one of these five types of stripping materials mentioned have many advantages and disadvantages, but there is always one job for which a particular type is more proficient. Only too often when a material does a satisfactory job on one type of coating, it is tried on others with varying degrees of success. Stripping materials are like analytical reagents in that they are specific in operation. A radical change in the type of coating changes the effectiveness of the stripper. One must remember that to this date there is no one stripper for all types of coatings. Not enough emphasis can be put on the fact that there is no universal print stripper.

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Recording of the American Electroplaters' Society 41st Annual Convention—New York City, July 12-15, 1954

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Effect of Anode Composition in Acid Copper Plating—*Nevers*	15	18	15
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Corrosion Properties of Electroless Nickel—*Gutzeit*	15	18	15
A Correlation of Metallurgical Hardness and Buffability—*Modjeska*	12	15	12
The Equipment to be Used for Determining the Effects of Oxide Films—*Feder*	15	18	15
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AES OFFICERS
1954-1955

Ralph A. Schaefer
President

Born near Grafton, Ohio, on August 16, 1913; studied first at the University of Notre Dame, then at Western Reserve University. He received his B.S. degree in 1935, a M.S. degree in 1936 and a Ph.D. degree in physical chemistry in 1941, all from Western Reserve University.

Associated with Cleveland Graphite Bronze Company, Cleveland, Ohio, since 1936; was director of research 1945–1953 and was named vice-president, Clevite-Brush Development Company in 1953. Known for fundamental work in the practical development of plated bearings and as author of many technical articles on related subjects.

Served as president of the Cleveland Branch, AES; was member of AES Research Committee 1946-1949; was chairman of the AES Research Project No. 11 and was named research supervisor in 1950; acted as associate editor of PLATING since 1946. Held many offices in the Electrochemical Society; active in the ASTM and many other technical and scientific societies.

Clyde Kelly
First Vice-President

Born in Indiana County, Pa., on September 9, 1902. Has educational background that includes several technical extension courses.

Associated with the American Plating Company, 808 Keo Way, Des Moines, Iowa and formerly with Superior Plating Co., Chicago, Ill.

Twice president of the Chicago Branch AES; general chairman of the 1952 National Convention and Exposition at Chicago. Recently honored by the Chicago Electroplaters Institute as "Plating's Man of the Year." Also chairman of the Research Finance Committee and chairman of the Committee on the Broadening of the AES Base.

Samuel Heiman
Second Vice-President

Born in Philadelphia, Pa., on December 18, 1909. Studied at University of Pennsylvania which awarded him a B.S. in Chemical Engineering in 1930 and a Ph.D. degree in Physical Chemistry in 1948.

Employed with A. Kenneth Graham and Associates as research engineer and plating consultant for seven years, at Battelle Memorial Institute as research electrochemical engineer, 1942–1943, and since 1943 at Philadelphia Rust Proof Company as chief chemist and technical director. Author of many papers on electroplating subjects.

Officer of the Philadelphia Branch, AES 1945–1953. President, 1949–1951, general chairman of the 1953 National Convention at Philadelphia.

Francis T. Eddy
Third Vice-President

Born in Pittsfield, Mass., July 2, 1915; received his A.B. degree in chemistry from Brown University in 1937 and attended the Juilliard School of Music, New York, from 1939–1940.

Associated with the Chase Brass and Copper Company, Waterbury, Conn., 1946–1954; as superintendent of finishing and assistant plant superintendent. Now general manager Technicraft Laboratories, Inc., Thomaston, Conn.

Served as president of the Waterbury branch, chairman of the New England regional meeting, chairman of the AES paper awards committee and has been an AES member since 1938; was on ASTM-B8 committee.

Performed meritoriously in World War II in the U.S Navy as LCT and LST commander and attained grade of lieutenant.

George P. Swift
Past President

Born in Boston, Mass., on August 9, 1903; S.B., 1924, and S.M., 1928, in electrochemical engineering, Sc.D. in metallurgy, 1944, all from M. I. T.

Taught electrochemistry and metallurgy at M. I. T. 1924–1944; began independent consulting practice in 1930; since 1944 operates electrochemical and spectrographic laboratories in Watertown, Mass.; director of Alice Ames, Inc., Boston; executive secretary, Master Metal Finishers' Association, since 1947.

Officer of Boston Branch, American Electroplaters' Society, since 1941; president 1942–1945; assistant to secretary-treasurer, 1945–1946; secretary-treasurer, 1946– . Officer, Boston Section and director, AIME; active in ASTM and other societies. Also listed in "Who's Who in New England," "Who's Who in the East," "Who's Who in Engineering," "Who Knows and What," "Who's Who in Commerce and Industry," and "American Men of Science."

Convention Echoes

By D. Gardner Foulke, *Hanson-Van Winkle-Munning Corp.*

Starting with the kick-off functions on Sunday evening—a documentary film on New York City, entitled "The Twenty-Four Dollar Purchase," and a Get-Together Party—to the final banquet Thursday evening the Forty-First Annual Convention of the American Electroplaters' Society was a continuous round of activity seasoned to a turn by the members of the New York Convention Committee.

The convention was called to order Monday morning by General Chairman George Schore, when he introduced the Reverend Frank Mesle who pronounced the invocation. A stirring address by the Honorable Wayne Morse of Oregon on "American Foreign Policy" provided an outstanding beginning for the convention.

The meeting was then turned over to President Swift, who called the Supreme Society to order. Vice-President Clyde Kelly reported a Portland Branch as receiving a charter and San Antonio, Seattle, Capitol District and Southern Tier Branches as having received temporary charters. The Committee on Paper Awards, Francis T. Eddy, Chairman, announced the paper award winners: the Carl E. Heussner Award went to Dr. Henry Brown and Edwin W. Hoover of the Udylite Corporation of Detroit for their paper, "A Corrosion Study of Various Chromium Plated Electrodeposits." They received the AES "Gold Medal Award," a certificate and a cash award. Winner of the Second Prize (AES Silver Medal) was Alexander Korbelak, Sel-Rex Precious Metals of Belleville, N. J. for his paper, "Plating on Molybdenum." Third Prize (AES Bronze Medal) went to Stanley L. Eisler, Jodie Doss and Miss Mary Ann Henderson of Rock Island Arsenal, Illinois. Their paper was on "Radiometric Study of Supplementary Chromate Coatings for Zinc and Cadmium Plating." The Mechanical Finishing Award by the Lea Manufacturing Company went to Walter L. Pinner of Houdaille-Hershey Company, Detroit. His paper was on "A Further Study on the Effects of Abrasive Metal Polishing on the Character of Nickel Plate." Martin F. Quaely of Westinghouse Electric Corp., Bloomfield, N. J. received the Chromium Plating Award for his paper on "Black Chromium-Base Electroplating." The Precious Metal Plating Award went to Edwin C. Rinker of Bart-Messing Co., for his paper on "Bright Gold Plating."

The first business session concluded with a brief review of matters to be covered in the final session on Thursday.

Jodie Doss (left) of Rock Island Arsenal receiving Third Prize (AES Bronze Medal) on behalf of Mary Ann Henderson and Stanley J. Eisler from Dr. George P. Swift. Doss, Henderson and Eisler were joint authors of the prize-winning paper, "Radiometric Study of Supplementary Chromate Coatings for Zinc and Cadmium Plating"

Educational Sessions

A total of twenty-six papers were presented at five educational sessions, and one was read at a special luncheon on Tuesday. All sessions were exceptionally well attended.

Chairmen of the sessions included the following: first session—Earl W. Arnold, Los Angeles Branch; second session—E. J. Roehl, Cleveland Branch; third session—Francis T. Eddy, Waterbury Branch; fourth session—Robert G. Parker, Bridgeport Branch; and fifth session—David J. Griffin, Southeastern Branch.

To the wide variety of papers presented should be added one by Dr. Henry Walker on "Modern Techniques in Aluminum Treatment" which was read by Milton Nadel following the Tuesday noon luncheon. As is customary all papers will be printed in their entirety in this and future issues of Plating.

It would be well to note under this heading that all the papers presented in the Hotel Statler during convention week were not sponsored by the AES. The National Federation of Metal Finishers held their Second Management Seminar on Tuesday at which time the following papers were presented: "Managing a Job Shop Under Today's Conditions" by Louis J. Donroe, "Specific Labor Relations Issues of the Plating Industry" by Ludwig Teller, "Building a Job Evaluation Program for the Metal Finishing Shop" by Kenneth Eaton, and "A Look into the Future of the Job Shop Plating Industry" by Silvio C. Taormina.

. . . . PAPER AWARD WINNERS . . . .

H. Brown Gold Medal | E. W. Hoover Gold Medal | A. Korbelak Silver Medal | S. L. Eisler Bronze Medal | W. Pinner Mechanical Finishing Award | M. Quaely Chromium Plating Award | E. C. Rinker Precious Metal Award

The Social Program

Conventioneers and their wives gathered in the Grand Ballroom Monday evening for a round of fun, as guests of the MFSA at the annual "Open House." As usual, the International Fellowship Club affair proved to be a high spot of the convention. Almost as soon as the party began, old-timers and new members alike were having a good time.

Dance music was provided by Vincent Lopez and his orchestra. The dancers paused at 10:30 for a delicious buffet supper. Then the revelry continued with drawings for U. S. Defense Bonds interpolated between dance numbers.

This thoroughly enjoyable evening was the result of a lot of hard work by the MFSA. All the platers who were present can agree that the suppliers deserve a vote of thanks for their successful efforts under the guiding hand of perennial Committee Chairman Tom "Open House" Trumbour.

This quote from the H-VW-M Convention News well describes this event; we only need add the names of the Defense Bond winners who were: Charles Temple, Globe Slicing Machine Co., Stamford, Conn.; W. E. Neumeister, Cincinnati Cleaning Machinery Co., Buffalo, N. Y.; Stanley Coe, The Du-Lite Chemical Corp., New Britain, Conn.; Ernest F. Hutt, United Chromium, Ltd., Toronto, Ontario; and Mrs. Sheila Boyar, Flushing, L. I.

Close to 25 Branch Secretaries and representatives attended a luncheon on Monday and took part in a timely and interesting discussion.

Tuesday morning found the Michigan State College Alumni, 13 of them, breakfasting and honoring Dr. Ewing. At noon the Grand Ballroom was crowded with the male registrants as the New York Branch provided food, entertainment and education. Dr. La Yellk, who turned out to be Sam Birch, double-talk linguist, provided the entertainment; the paper on aluminum treatment, already referred to, supplied the education.

Wednesday afternoon found almost all registered leaving en masse for the "Liberty Belle" to try to catch some of the cooling Hudson zephyrs. Not many zephyrs were found; but the trip, the dancing, and fun with friends, were enjoyed mightily and thanks go to Frederick Gumm Chemical Co., sponsor of the affair.

John Gumm and Joe Duffy greeted about 60 golfers at the Forest Hill Field Club, Bloomfield, N. J. Winners were: Gus Manganello, White Plains Electroplating Service, first prize; Phil Ammirato, Guild Platers, second prize; Joe Eisele, Enthone, Inc., third prize; Harold Marsh, Hammond Plating Corp., fourth prize, and John Manganello, White Plains Electroplating Service, fifth prize.

The Banquet Thursday evening was hailed by all as one hard to surpass. Starting with roast beef and all the trimmings, surfeited and happy, the AES conventioneers relaxed to enjoy a top show including Joe Sodja and his guitar, comedian Johnny Woods, song writer Joe Howard, comedian Peter Donald, dancing by the Szonys and comedy team of Bernard Brothers.

Dancing followed as did visits to the rooms of the various suppliers, each one of whom deserves the thanks of close to 1,500 registrants for doing so much to make the convention the great success it was.

Among the various prize awards made during the week included those made by Hanson-Van Winkle-Munning Company at the banquet—a silver tea set in Lancaster Rose design, won by Edwin Wallin; an RCA high-fidelity phonograph, won by Helen Stengel—both of Rochester—and two La Cross stainless steel manicure sets to Mr. Al Scafuri, Belke Manufacturing Co., Chicago.

THE BUSINESS SESSION

The final business session of the 41st Annual Convention was held Thursday afternoon. A roll call of Past Presidents found H. A. Gilbertson, E. T. Candee, G. Wagner, W. L. Pinner, S. S. Johnston, C. F. Nixon and Franklyn MacStoker on hand.

Appointments and Awards

Appointments to the Research Committee were announced as being Arthur Du Rose, Harshaw Chemical Company; Lloyd Gilbert, Rock Island Arsenal, and Arthur Wrisberg, Lasalco, Inc. Dr. E. J. Serfass continues as Chairman and Leslie Borchert as Vice-Chairman, Research. Robert Racine succeeds R. F. Ledford as Vice-Chairman, Finance.

New members of the Editorial Board are Howard McAleer, Formax Manufacturing; Harold Wiesner, Bendix Products Division, and R. D. Miller, Electric Auto-Lite, with J. Winters, R. O. Hull & Co., and A. Brenner, Bureau of Standards, serving as liaison members for the Cleveland and Washington Convention committees, respectively.

Clyde Kelly presented the Membership Awards to Detroit, Syracuse and Western Ontario Branches.

The Branch Exhibits Awards were presented by Third Vice-President Heiman to Columbus Branch, first prize; Newark Branch, second prize, and Chicago Branch, third prize. Individual exhibit awards were presented to Rockwell Silver Company, Meriden, Conn., first prize; to Ajax Manufacturing Co., Torrington, Conn., second prize; and Torrington Company, Torrington, third prize. The special award was made by the New York Branch for the best exhibit of metallographic work and went to Wright Aeronautical Division, Curtiss-Wright Corporation of Woodridge, N. J. An Honorable Mention Award was given the Masters' Electro-Plating Association for an outstanding noncompetitive display.

The resignation of A. Korbelak, editor of Plating, and the appointment of L. Morrison as the new editor was announced. The new advertising manager of Plating, George Burnley, was introduced.

Arthur Pierdon spoke briefly on the way the resolution re Dr. Allen Astin, passed last year, had been fulfilled, and Clyde Kelly reported on the activities of his committee for broadening the scope of the Society. Dr. S. Heiman reported progress in the preparation of a Branch Officers' Manual and a Convention Committee Manual.

The per capita tax forgiveness granted the Australian Branches last year was reported as reconciled and that in the future full payment will be made.

President Swift also reported that there had been some discussion with regard to paying authors for articles in Plating. No action was taken by the Supreme Society.

George Schore nominated Franklyn J. MacStoker to Honorary Membership in the Society. Mr. MacStoker was duly elected an Honorary Member and it is an interesting aside that he, although a member of the Executive Board, did not know that this honor was planned.

The election of officers found the incumbents moved up a notch and Frank T. Eddy of the Waterbury Branch elected Third Vice-President.

Cleveland F. Nixon installed the new officers. R. A. Schaefer received the silver plated gavel, presented each year by Ted Boggess, and took over the chair for the remainder of the meeting which included reports by Gene Combs on the Cleveland Convention and Metal Finishing Exposition, by Art Pierdon on the Washington Convention, and by J. J. Roche on the 1957 Convention in Montreal. The Cincinnati Branch requested permission to be host for the 1958 Convention which was granted as was a request by Detroit for the convention and Metal Finishing Exposition for 1959—the fiftieth anniversary of the Society.

The business session concluded with a report by Walter Pinner on the Fifth International Conference on Electrodeposition.

Associated Organizations

No recital of the events of an AES Convention Week would be complete without reporting the activities of the various associated organizations which meet at the same time.

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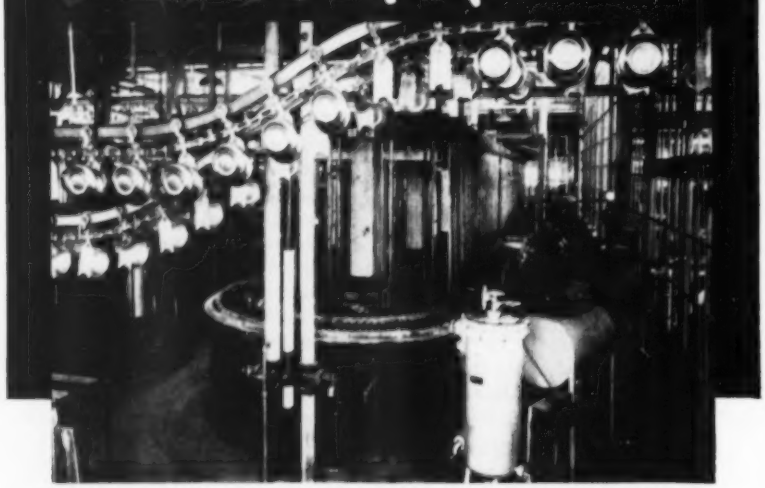

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MFSA

The Metal Finishing Suppliers Association held its annual business meeting following a luncheon on Tuesday. Officers elected to carry on during the 31st year included Manson Glover, President; Herman Struckoff, First Vice-President; Joe Duffy, Second Vice-President, and M. M. Beckwith, Third Vice-President. The MFSA sponsored the International Fellowship Club Open House Monday night and the golf tournament on Thursday.

NAMF

The National Association of Metal Finishers held their Board of Directors' meeting Sunday morning and the annual meeting that afternoon, leaving the rest of the week free for members to attend the AES Convention. The officers for 1954 will be W. F. Walton, Walton and Lonsbury, President; Clifford Wheeler, Elyria Plating Works, First Vice-President; John Helfinger, Helfinger Corp., Second Vice-President; Arthur Pierdon, Art Metal Finishing Co., Treasurer.

NFMF

The National Federation of Metal Finishers met Tuesday for a four-part seminar for which the Masters' Electro-Plating Association of New York acted as host organization. Details of the seminar were reported earlier.

Order of Past Presidents

The Royal Order of the Pot has become the Order of Past Presidents, but the central ceremony has not changed. The New York Branch entertained the past presidents and their wives at dinner in the Sky Top Room Monday night. This occasion served the dual purpose of providing a time for the annual meeting of the OPP and making possible a gala social event.

A National Past President's pin, made into a tie clasp, was presented by Past President MacStoker to all attending Past Presidents on behalf of the New York Branch.

Ladies Program

The Ladies' Committee with Mrs. Barbara Schore as Chairman arranged a full and exciting program. As has been the custom in the past, this phase of convention activities will be reported by one of the ladies herself in a later issue of PLATING.

More pictures and information on the Convention in the next issue.

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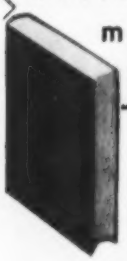

Here are the basic theories and principles of electroplating—practical methods and processes of invaluable use to everyone concerned with electroplating and electrotyping. The most efficient methods of making electrodeposits of more than 40 different metals and alloys on metals and plastics are summarized completely in this book. It brings you simple explanations of principles of electrochemistry and physics that underlie plating processes, and takes up improvements in electrodeposition procedures and products.

Principles of ELECTROPLATING and ELECTROFORMING

By W. BLUM, Chemist, U. S. Bureau of Standards, and G. B. HOGABOOM, Consultant

3rd Ed., 455 pp., 24 tables, illus., $7.00

This practical working tool summarizes and digests the best of modern practice in the field. It covers methods used for qualitative, quantitative analyses of solutions; pickling, dipping; electropolishing; electroforming, electrotyping, producing phonograph record matrices, and manufacturing tubes, etc.

The metals are dealt with fully in the same order as in the periodic system of elements—making application of specific data direct and easy. You get a description of deposition on metals and plastics, and of alloys including brass, bronze, tin-zinc, nickel-molybdenum, etc. Numerous tables show resistivities of solutions, hardness of electrodeposited metals, and other valuable electroplating engineering tables and data.

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Book Review

By DOMENIC MENCIO
United Chromium, Inc.

MODERN ELECTROPLATING, sponsored by the Electrochemical Society, edited by Allen G. Gray, xii + 563 pages, John Wiley & Sons, Incorporated, 440 Fourth Avenue, New York 16, N. Y. Price $8.50.

The second edition of the earlier Modern Electroplating, 1942, has been compiled by 39 specialists in diversified fields. It was written to present up-to-date electroplating theory and practice. Briefly, the book is organized in the following manner: Chapter one deals with general principles of electroplating practice such as types of solutions, mechanism of deposition, current distribution, and properties of electrodeposits. Chapter two deals with methods of control; chapter three deals with alloy plating. The other sixteen chapters are in alphabetical order and each is devoted to a specific plating solution. Each one deals with bath constituents, function of bath constituents, operating conditions and characteristics, and in most cases a section on maintenance and control.

Chapter eighteen is devoted to uncommon metals. Among these are aluminum, antimony, arsenic, beryllium, bismuth, magnesium, manganese, molybdenum, selenium, titanium, tungsten, uranium, to mention a few. There is also a chapter on plating on aluminum and magnesium, as well as an appendix containing tables of useful data and miscellaneous information for electroplaters.

While an unfavorable review has been noted, and there may be some incompleteness and lack of up-to-dateness in spots, possibly an illustration of the reviewer's experience with the book as a ready reference for platers will best demonstrate what he believes to be its intended use. One of our customers who recently asked for assistance, was experiencing difficulty in the operation of a rochelle salt cyanide copper bath. The fine points of operation and control of this type of bath being somewhat outside the immediate knowledge of the writer, he referred to the chapter on this in the book and quite satisfactorily arrived at the answer to the customer's problem. In fact, he referred the customer to the book for future reference.

A very large amount of basic information has been assembled in a form which makes it available for ready reference. This undoubtedly will be an outstanding reference book on plating bath composition and control for many years to come.

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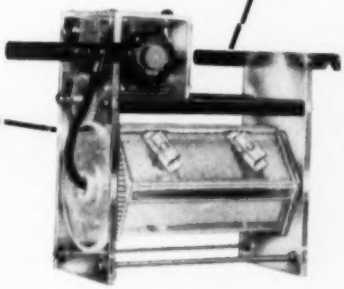

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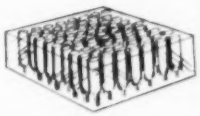

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Article Abstracts

No copies of articles are available at the offices of "Plating". Photostats may be had from libraries having files of the journal in question and offering photostat service, usually at 30-50 cents a page. Ask your public library to consult the Union List for names of libraries having the particular journal. Abbreviations used are those of Chemical Abstracts.

On the Experimental Methods for the Determination of Electrode Polarization. R. Piontelli. Trans. Inst. Met. Finishin , 1954, 31, Advance Copy No. 5.*

The principles of two new arrangements, which eliminate the systematic errors involved in the use of the Luggin-Haber capillary, are given.

Radiotracer Study of Electrochemical Displacement on Metals. M. Simnad, A. Spilners, and Ling Yang. Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 6.*

Radiotracer studies of the displacement of silver from silver nitrate solutions by copper, iron and nickel have been made, using radiosilver. The rate of displacement is increased by oxidizing the surface and by increasing the silver nitrate concentration; in the case of copper, it is greater for annealed surfaces than for cold-rolled.

Corrosion or Protection at Gaps in Metallic Coatings on Steel. U. R. Evans. Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 8.*

The state of affairs at a gap varies according as the coating metal is cathodic or anodic to steel, but a given metal may be cathodic in some circumstances and anodic under others. A departure from the normal polarity may occur if the liquid contains complex-forming substances; thus tin, generally cathodic to steel, becomes anodic in the presence of fruit acids—which explains why tin canisters can be used for canning fruits. Again coatings of anhydrous oxide (which transmit electrons) shift the potential in the cathodic direction, while coatings of hydrated oxides (which transmit ions) shift it in the anodic direction. Impurities in alumina facilitate the transmission of electrons, and pure aluminum (covered with an almost nonconducting oxide film) is anodic to aluminum-copper alloys (which form a better conducting oxide film); this explains the success of cladding such alloys with pure aluminum.

A gap in a cathodic coating occasionally may cause corrosion more intense than that which would occur on uncoated steel, but such intensification is rare. Several cases where definitely

*Presented at the 4th International Conference on Electrodeposition and Metal Finishing, April, 1954, London, England.

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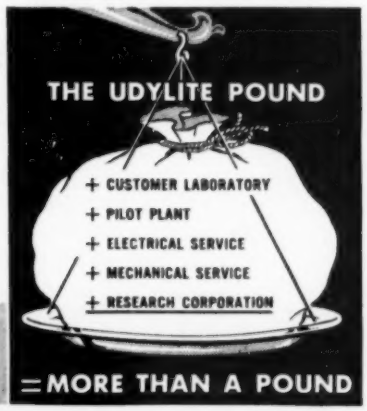

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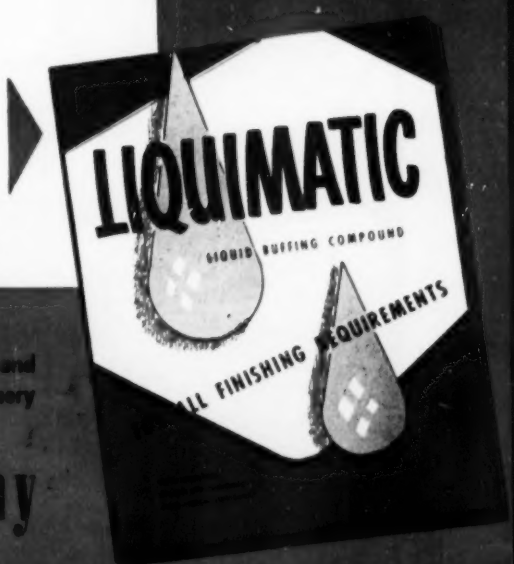

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Article Abstracts

porous coatings of cathodic metals provide effective protection are known; these include porous coatings of lead for protecting steel against industrial atmospheres, and the highly discontinuous tin coats that can be applied to steel before painting. Explanations of these and other cases, based on well-established electrochemical principles, can be suggested.

A gap in an anodic coating does not lead necessarily to corrosion of the exposed steel, which often receives cathodic protection. In the opening stages, the metal may be "sacrificed" to provide this protection, but in many circumstances, the cathodic reaction then deposits a layer (calcium carbonate, zinc hydroxide or aluminum hydroxide in different cases—sometimes converted later to clinging, protective rust) and prevents attack on the steel in a way which involves no attack on the coating metal.

A Quantitative Adhesion Test for Electrodeposited Chromium. C. Williams and R. A. F. Hammond, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 9.*

This paper describes the development and standardization of a quantitative test for determining the adhesion of chromium deposits to the basis metal. Fracture of the chromium normally sets a limit to the stress which can be applied at the interface, but adhesion values up to approximately 20 tons/sq in can be investigated.

The test has been applied to determine the influence upon the adhesion value of certain variables including substrate material, cleaning methods, conditions of chromium deposition, heat-treatment, and the results afford information on the structure and mechanical properties of electrodeposited chromium.

The Diffusion of Chromium and Other Elements Into Nonferrous Metals. R. L. Samuel and N. A. Lockington, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 11.*

This paper is an account of experiments carried out during the last 5 years on the diffusion of metals into nickel and its alloys from the gas phase, particularly the diffusion of chromium and molybdenum. The method of processing is given briefly, and the composition, structure and chemical properties of the coatings obtained are discussed.

Nickel Plating from the Sulfamate Solution. Myron B. Diggin, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 16.*

This paper presents a review of early work with sulfamate electrolytes and reports certain new developments on nickel plating from sulfamate solutions.

*Presented at the 4th International Conference on Electrodeposition and Metal Finishing, April, 1954, London, England.

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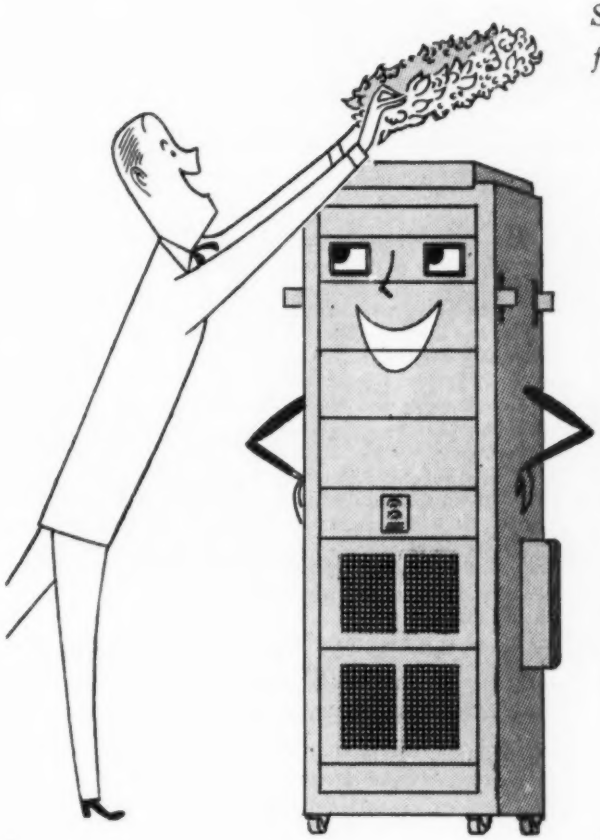

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Article Abstracts

Experimental work is described which deals with the nickel sulfamate bath with and without addition agents. Particular emphasis is given to the physical properties of the deposits and the effect of bath composition and operating variables on stress, hardness, tensile strength, elongation and ductility. Photomicrographs showing the structure of the deposits and data on certain electrical properties are presented.

The results of these studies indicate that the nickel deposits produced from the sulfamate bath are particularly applicable to engineering and functional uses. Several such applications are described.

Notes on Cleaning Cycles for Plating. A. Kenneth Graham, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 17.*

An account of cleaning procedures found suitable for cleaning steel, buffed copper and buffed nickel surfaces prior to nickel plating is given. A "peel" adhesion test found useful for evaluating the various cleaning procedures is described.

Infrared Stoving for Paint Finishes. J. Tole, Savart, and L. Hulin, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 20.*

The need to raise the temperature of painted motorcars in order to polymerize the synthetic enamel coating has led to the use of infrared radiation as the heating agent. Because radiation can be directed and does not require the intervention of any material transfer medium the process is both rapid and controllable. The quality and intensity of the radiation depend on the temperature of the emitting source. A suitable source has been found in underrun tungsten filament incandescent lamps, which may be built into a lightweight stove needing little ventilation and no insulation. The design of such stoves and the principle of selecting the emitter is derived from a study of the laws of radiation. Infrared heating by lamps is peculiarly suitable for finishing and retouching motorcars painted in synthetic enamel.

The Resistance of Some Case and Plated Sleeve-Bearing Materials to Cavitation Erosion. R. A. Schaefer, J. F. Cerness and H. A. Thomas, Trans, Inst. Met. Finishing, 1954, 31, Advance Copy No. 26.*

Apparatus for producing high-frequency vibration of metal specimens in oil, to simulate natural cavitation erosion conditions, is described.

Tests on 23 bearing materials have shown that only coplated 98–2 silver-lead and cast 74–10–16 copper-tin-lead show promise for use in high-speed sleeve-bearing applications where high-frequency loads and high temperatures are operative.

A Laboratory Technique for the Electrodeposition of Manganese on Other Metals. Winifred A. Bell, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 27.*

A technique for the deposition of bright smooth manganese plates is described, utilizing an electrolyte containing 112 g/l of $MnSO_4 \cdot 4H_2O$, 139 g/l of $(NH_4)_2 SO_4$, 1 g/l of citric acid and small additions of hydroxylamine sulfate, in a divided cell with bagged carbon anodes. The best results were obtained at temperatures of 20–32° C with a cathodic current density of about 23 amps/sq dm; moderate agitation of the catholyte, and water-cooling, are desirable. The initial *p*H of the solution is adjusted to 5; that of the catholyte rises to 8.5 during deposition.

Only α-manganese could be found in the deposits, which had hardness between 550 and 725 DPN. The deposits soon became tarnished with a brown film. Tests have shown that they give cathodic protection to steel and aluminum.

*Presented at the 4th International Conference on Electrodeposition and Metal Finishing, April, 1954, London, England.

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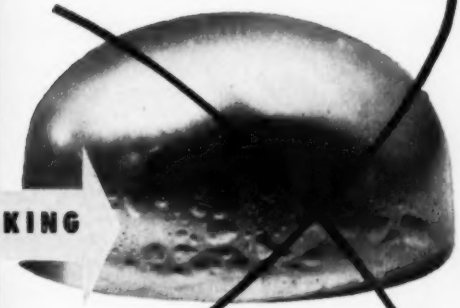

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Article Abstracts

Progress in Tin-Nickel Electroplating. A. E. Davies, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 23.*

An investigation of the effect of fluoride concentration on alloy deposition from tin-nickel electrolytes is described. Evidence for the existence and stability of the complexes SnF_4^{--} and SnF_6^{--} is adduced; deposition of the alloy NiSn is shown to be associated with the formation of the complex SnF_4^{--}. Deposition of bright tin-nickel alloy plate is not possible from solutions in which uncomplexed Sn^{++} ions are present. The relation between $[Na^+]$ and $[Sn^{++++}]$ in the chloride-fluoride electrolyte is discussed.

In the light of the information thus gained some modifications in the constitution of the electrolyte and in maintenance procedure for the practical deposition of the tin-nickel alloy are suggested. Such modifications have for their aim (a) maintenance of the fluoride concentration at the optimum value, (b) reduction of the loss of hydrofluoric acid, when the bath is working, to a minimum.

Universal Metal Finishing Problems—A Plea for International Cooperation. S. Wernick, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 29.*

Many problems which confront metal finishers are of a universal character. Their solution would bring immense benefit to all engaged in the industry. An international cooperative effort to solve the most urgent of these problems, examples of which are enumerated, directed by a central authority and utilizing the resources of laboratories in Europe and the U.S.A. is advocated. Such a project would pool technical resources, eliminate duplication of effort and accelerate the production of the desired results.

Glass-Fiber Reinforced Plastics: A New Material of Construction for the Finishing Industry. H. Silman, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 30.*

The paper presents a review of materials of construction for use in plating processes, discusses rubber, polyvinyl chlorides and then describes in detail the recently developed glass-fiber reinforced plastics. Two tables and 8 references are included.

The Electrodeposition of Porous Metal. Charles L. Faust and William H. Safranek, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 31.*

An account is given of the production of coherent porous electrodeposits of copper, nickel and zinc by the use of Aquadag colloidal graphite as an addition agent. Coherent deposits of at least 50 per cent porosity have been produced.

*Presented at the 4th International Conference on Electrodeposition and Metal Finishing, April, 1954, London, England.

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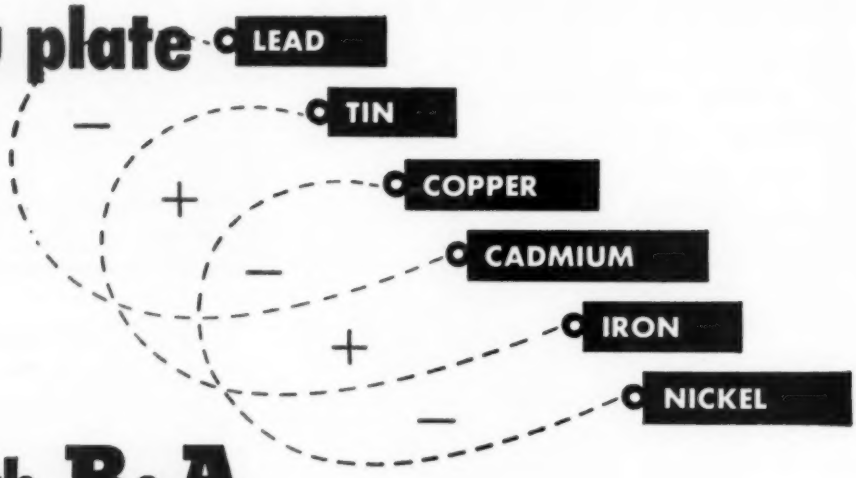

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Article Abstracts

Unsolved Problems in the Metal Finishing Industry. W. L. Pinner, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 28.*

Urgent problems which need to be solved in the electroplating field include the establishment of a reliable corrosion test for plating, the development of a process to produce a ductile bright nickel deposit, and the development of a satisfactory cyanide-copper electrolyte.

Phosphoric Acid Anodizing of Aluminum and Its Application to Electroplating. R. C. Spooner and D. P. Seraphim. Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 3.*

The results are presented of a quantitative study of the phosphoric acid anodizing of high-purity aluminum. The effects of electrolyte concentration, temperature, anodizing time, current density and air agitation on the coating weight, metal loss, coating ratio and density of the anodic coating were investigated.

The use of phosphoric acid anodic coatings as a base for electrodeposition is discussed with particular reference to plating in a copper pyrophosphate solution and the growth of copper deposits in the anodic film. Tests of chromium/nickel/copper electrodeposits on 3S aluminum alloy are described briefly.

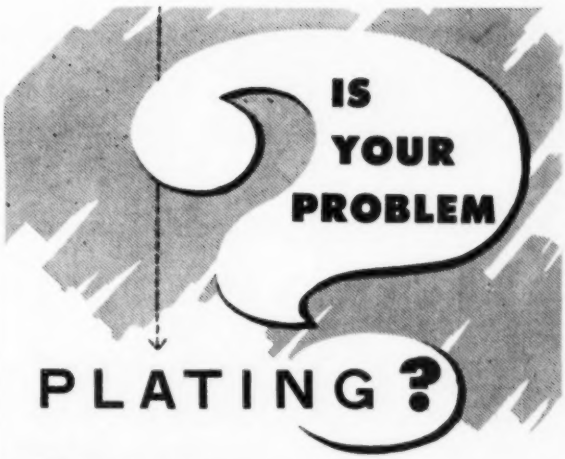
The Electrodeposition of Gold and Other Alloys by a New Method. G. E. Gardam and N. E. Tidswell, Trans. Inst. Met. Finishing, 1954, 31, Advance Copy No. 25.*

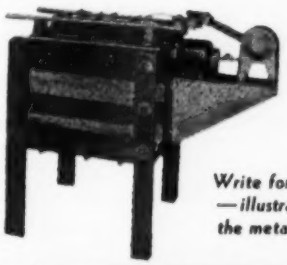
The difficulties of electrodepositing an alloy of a required composition by control only of the chemical composition of the solution may be overcome largely by arranging the solution composition so that one constituent metal is deposited preferentially, but rapidly exhausted, from the cathode film. By applying a pulsed direct current all the preferentially deposited metal is deposited from the cathode film in each pulse, together with some of the second metal; conditions are restored by diffusion of ions during the rest period. By adjustment of the actual and relative on- and off-current times the average composition of the alloy can be adjusted without change of composition of the solution, or to allow for unintentional changes in the solution.

Examples of the application of the method to electrodeposition of brass and of gold alloys are given. It also has been found, that the brightness of electrodeposition of gold alloys can be maintained to a greater thickness by short-circuiting the anode and cathode during the off-current periods.

Suitable switching apparatus for the pulsed current is described.

*Presented at the 4th International Conference on Electrodeposition and Metal Finishing, April, 1954, London, England.





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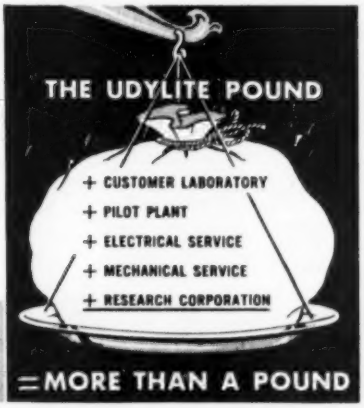

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Patent Abstracts

DR. D. GARDNER FOULKE

Manager, Electrochemical Development
Hanson-Van Winkle-Munning Co.
Matawan, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

2,668,130, February 2, 1954—Apparatus and Method for Continuous Pickling and Regeneration of Contact Acid—Edwin Martin, assignor to Koppers Company, Inc., Pittsburgh, Pa.

A continuous cyclic process for pickling iron and steel and for regenerating the used pickle liquor is claimed. The pickle solution consists of a 14–22 per cent by volume solution of sulfuric acid and is operated at 180° to 220° F. These conditions permit rapid pickling at relatively high ferrous sulfate concentrations. The pickle liquor is continuously withdrawn and evaporated; sulfuric acid is added while the temperature is maintained at 180° to 220° F. Under this condition a rapid precipitation of the ferrous sulfate monohydrate occurs. Water is added to the concentrated pickle (required because of evaporation) to adjust the solution to 14–22 per cent by volume sulfuric acid and which then is returned to the pickle tank.

12 claims.

2,668,795, February 9, 1954—White Brass Plating—Christian J. Wernlund, assignor to E. I. duPont de Nemours and Company, Wilmington, Del.

The use of vanadium and an aliphatic-aromatic ether aldehyde to produce bright white brass deposits is claimed. The following bath composition mentioned as an example:

Zinc cyanide	60 g/l
Copper cyanide	15 g/l
Sodium cyanide	52.5 g/l
Sodium hydroxide	60 g/l
Sodium sulfide	0.5 g/l

The addition of small amounts of an aliphatic-aromatic ether aldehyde (piperonal bisulfite, vertraldehyde bisulfite, or anisaldehyde bisulfite, 0.2 to 7.5 g/l) and vanadium (as sodium orthovanadate, vanadyl sulfate or any alkali soluble vanadium compound, 0.01 to 0.5 g/l) will yield white brass deposits which are

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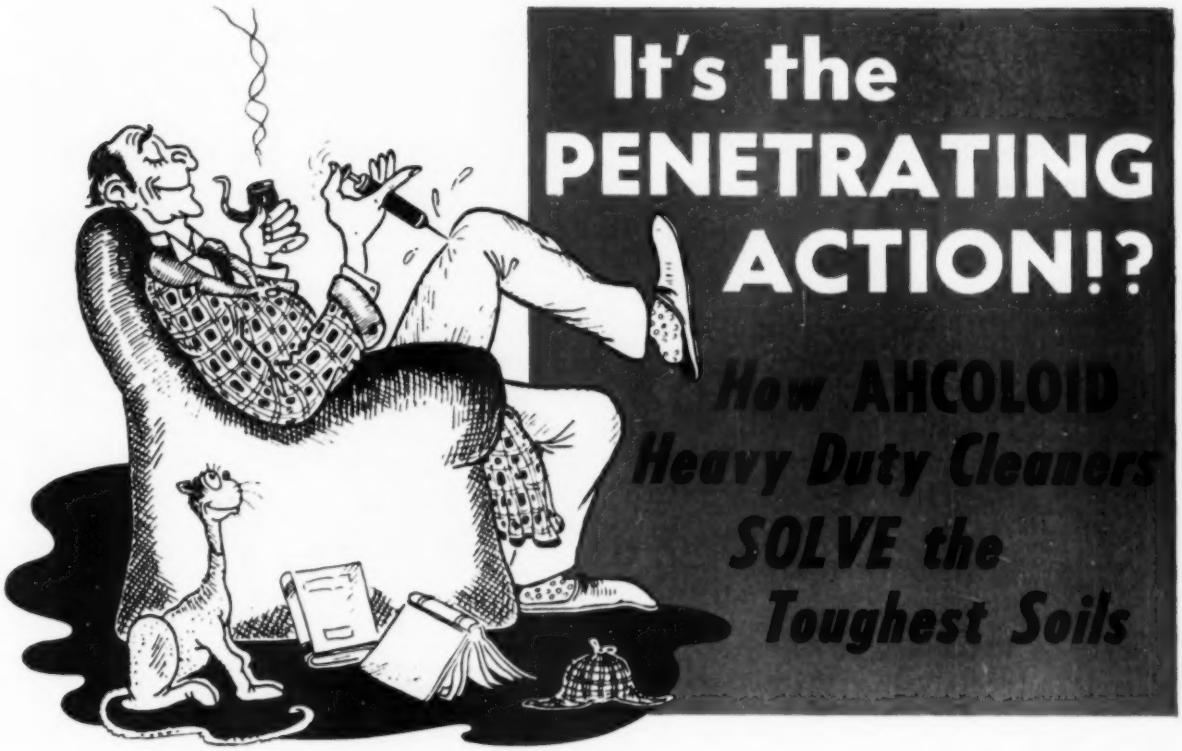

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LSI-10	100 gal/hr	12" x 16" x 16"	40 lb
ASI-300	300 gal/hr	2' x 2' x 2'	125 lb
ASI-400	400 gal/hr	2' x 2' x 2'	135 lb
ASI-600	600 gal/hr	2' x 2' x 2'	150 lb

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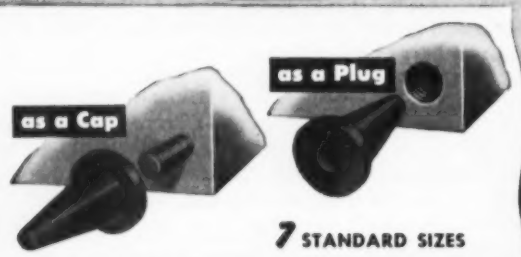

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Patent Abstracts

smooth and bright with a color closely approaching that of chromium.

7 claims, including the use of vanadium alone or in combination with said aldehyde.

2,671,717, March 9, 1954—Chemical Brightening of Aluminum—James T. Ferguson, assignor to General Electric Company, Schenectady, N. Y.

It is claimed that improved brightness or increased specularity of aluminum surfaces can be obtained by immersing the aluminum in a hot alkali bath (1–6 oz/gal) containing alkali nitrates or nitrites (2–6 oz/gal) at 145° to 165° F. It is claimed that this process differs from alkali etching processes in that the presence of nitrate and nitrite ions or both produces a brilliant, smooth, highly reflective and substantially unetched surface.

5 claims.

2,671,737, March 9, 1954—Aluminum Coating Process and Flux—Walter E. Jominy and John H. Olson, assignors to the Chrysler Corporation, Detroit, Mich.

A flux for steel prior to aluminum or aluminum alloy coating which is claimed to provide a good bond between the steel and aluminum consists, as per one example, in parts by weight:

Sodium fluosilicate	4–20
Potassium chloride	3–5
Sodium chloride	3–5
Sodium fluoride or cryolite	0.8–5

A suspension form of the flux may be produced by mixing the above in 100 parts by weight of water. After cleaning, the aluminum parts are immersed in this suspension and the flux dried on the work to form an envelope after which the parts are inserted into the molten aluminum bath and coated.

Claim 6 covers the process of forming corrosion resisting coatings essentially of aluminum on ferrous metal bodies using such a flux and procedure. The other claims cover the composition of the flux, the limits of which are somewhat broader than the preferred composition given above.

6 claims.

2,672,681, March 23, 1954—Method of Soft Soldering Magnesium—Paul Klain, assignor to Dow Chemical Co., Midland, Mich.

This method consists of removing the magnesium oxide and then pressing a soft solder in the molten state against the magnesium in the presence of at least one of the following compounds: benzoic acid or the anhydride, monochlorobenzoic acid, 2, 5-dichlorobenzoic acid or 2,5 dibromobenzoic acid.

7 claims.

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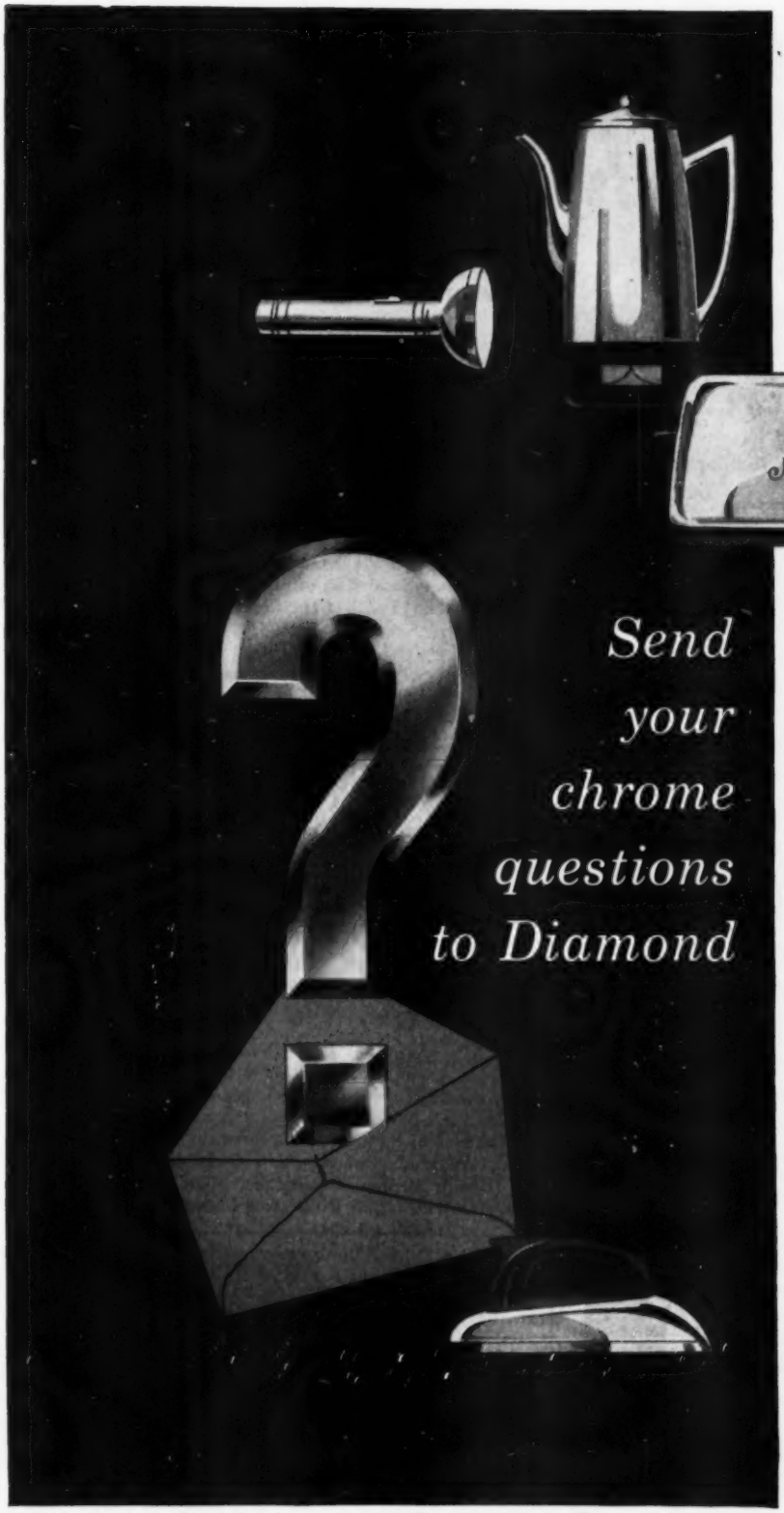

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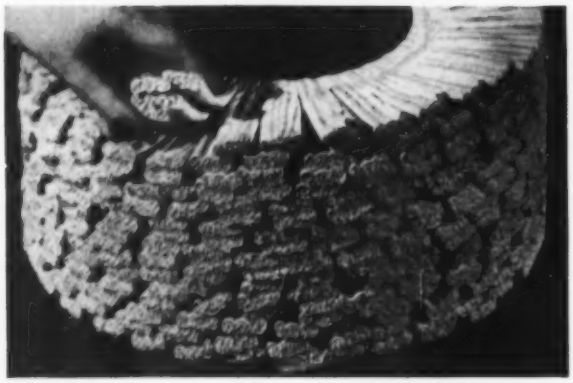

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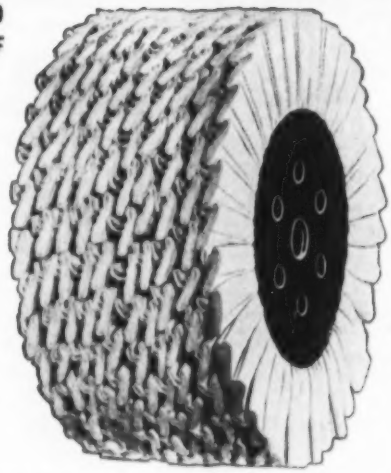

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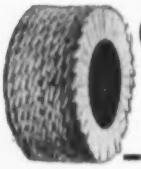

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Patent Abstracts

2,673,076, March 23, 1954—Rotatable Work Holder for Electroplating Apparatus—L. E. Colchester, assignor to Mercil Plating Equipment Company, Chicago, Ill.

A plating barrel is described for which is claimed greater plating capacity by virtue of its construction which is described in claim 1 as ". . . comprising a plurality of panel sections, the longitudinally extending adjacent edges of said panel sections being adapted to fit with one another whereby to form a cylindrical barrel, certain of said edges having greater thickness than the mid portions of the panel sections and having keying grooves formed therein and keying members positioned within the keying grooves in adjacent panel edges to hold said panel edges in juxtaposed assembled position." Other claims describe the use of tumbling projections in the corners of the barrel.

13 claims, 12 figures.

2,673,143, March 23, 1954—Producing a Mirrorlike Finish on Aluminum—Eugene R. Du Fresne and John R. Swihart, assignors to Diversey Corporation, Chicago, Ill.

This method of forming a reflective aluminum surface broadly consists of immersing the object in a caustic soda bath containing a large amount of an oxidizing agent and a smaller amount of polyhydric alcohol of the formula $CH_2OH(CHOH)_aCH_2OH$ where a is at least 4; polyhydroxy monobasic acids of the formula $COOH\ (CHOH)_c\ CH_2OH$ where c is at least 4; and lactones of polyhydroxy dibasic acids of the formula $COOH\text{-}(CHOH)_d\ COOH$ where d is at least 2. Good results on 2S aluminum are claimed for a bath consisting of

20 per cent NaOH
10 per cent sodium gluconate
50 per cent sodium nitrate
20 per cent sodium chlorite

when used in a concentration of 16 oz/gal at 205° F for 1½ minutes. Organic compounds include glucono delta lactone, glucoheptanoic lactone, sorbitol, mucic acid, glycerine and gum arabic. Oxidizing agents mentioned include sodium nitrate, sodium nitrite, sodium chlorate, sodium chlorite, sodium hypochlorite and sodium perchlorate.

15 claims.

2,673,180, March 23, 1954—Production of Electrolytic Zinc—Walter Arthur Emanuel, Kenneth O'Neill Sweeney, John Francis Mahony, assignors to Anaconda Copper Mining Company, New York, N. Y.

This invention claims an improvement in zinc refining by the electrolytic method whereby the codeposition of lead is inhibited by the introduction of strontium sulfate into the electrolyte. The strontium sulfate is dissolved in concentrated sulfuric acid

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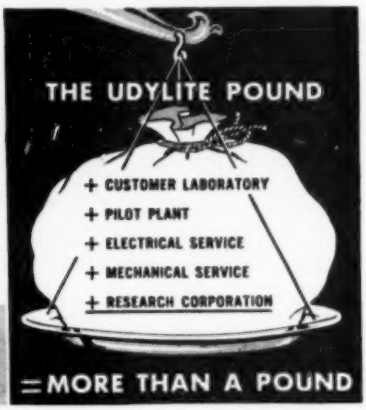
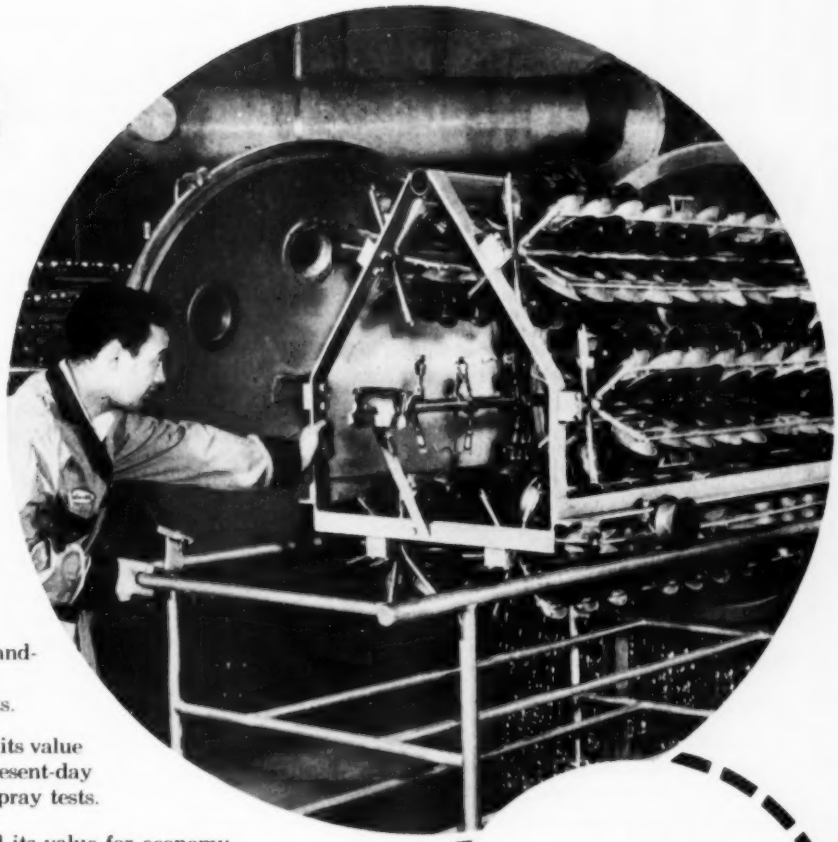


Vacuum Metallize

for High-Speed Low-Cost Finishing of Stampings and Die Castings



Packard parking lamp reflectors—720 to a load—enter the Stokes Vacuum Metallizing chamber at Detroit Plastics Molding Co., a leading metal finisher and plater. In a matter of minutes these reflectors will be brilliantly metallized.

Leading metal finishers are expanding their markets by vacuum metallizing many metal products.

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Stokes Laboratory will metallize your samples, evaluate your application, recommend techniques to be employed, plan cycles, report on costs . . . and share with you the benefits of Stokes' 40 years of leadership in high-vacuum technology.

Write today for a comprehensive brochure, "Vacuum Metallizing Today," which describes the applications and techniques of Vacuum Metallizing.

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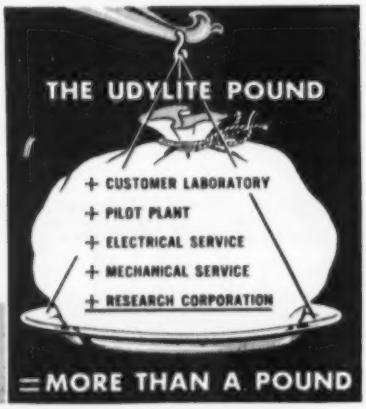

Patent Abstracts

and it is claimed this represents an improvement over the use of a strontium carbonate slurry presently used.

5 claims.

2,673,836, April 6, 1954—Continuous Electrolytic Pickling and Tin Plating of Steel Strip—Edwin E. Vonada, assignor to U. S. Steel Corporation.

This invention covers the continuous pickling of steel strip and the simultaneous deposition of a flash coating of tin prior to and in conjunction with electrotinning operations. The pickling and flash tin deposit are done by passing the steel strip through a 5–15 per cent sulfuric bath having a plurality of anodes therein, part of which are tin and part being silicon-iron (13–18 per cent silicon), spaced across the width of the strip, the tin anodes being 8–12 per cent of the total anode area. An anode current density of 150–250 amp/sq ft is employed.

4 claims, 3 figures.

2,674,523, April 6, 1954—Process and Composition for Treatment of Magnesium Prior to Spot-Welding—Louis McDonald and Alfred Hawley, assignors to Kelite Products, Inc., Los Angeles.

The process for cleaning magnesium prior to spot-welding comprises applying to the surface to be spot welded a viscous etching solution. The aqueous cleaning solution contains a polystyrene sulfonic acid, 2–10 per cent; a water soluble aliphatic carboxylic acid sequestering agent, 5–25 per cent; an aryl sulfonic acid with an aliphatic substituent having less than four carbon atoms, 2–10 per cent; and ammonia 0.1–1.7 per cent. An example is given as follows:

	Per Cent
Xylene sulfonic acid	5
28° Bé ammonia	0.5
Glucono delta lactone	6.75
Polystyrene sulfonic acid	6.0
Water	81.75

Citric, tartaric or gluconic acid may be substituted for the lactone.

7 claims.

2,674,550, April 6, 1954—Apparatus and Method for Processing of Steel Strip Continuously—Ralph Dunlevy and John H Shoemaker, assignors to Kolene Corp., Detroit, Mich.

Described is an apparatus to treat continuously steel strip in a molten alkali metal salt bath such as that described in U. S. Patent No. 2,458,661 (January 11, 1949) which cleans by transforming into easily removable oxides. The rollers at the after end of the tank are heated to keep the salts from solidifying, thus minimizing marring of the strip and assisting in forming a lubricating film about said rollers.

5 claims.

2,674,790, April 13, 1954—Method of Soldering Aluminous Metal Parts by Treating with Chloride Fluxes—A. P. Edson and Isaac L. Newell, assignors to United Aircraft Corporation, East Hartford, Conn.

A process of joining aluminum and alloys thereof by solder which includes fluxing at soldering temperature by means of a gaseous atmosphere substantially inert with respect to the metals, but reactive with the oxides. This atmosphere is provided by a volatile inorganic chloride having two or more chlorine atoms connected to a single atom and having a molecular weight of at least 117.

8 claims.

The use of iodide and bromide fluxes in a similar fashion is described in U. S. Patent No. 2,674,791 by the same inventors. The molecular weight for iodide and bromide fluxes should be at least 250.

7 claims.

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With the ordinary chromium bath, tank load was limited to only *six* bumpers because of current supply and coverage problems. Even at this rate, rejects due to coverage failures were running high.

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ADVANTAGES CONFIRMED

This is no isolated case of improvement in operations. Many reports verify that Unichrome SRHS Chromium Solutions provide new economy in plating, better coverage and increased productive capacity.

For example: SRHS increased bumper plating 33% at another plant. . . . It reduced bath upkeep costs 40% for still another user. . . . It hard plated work formerly requiring 3½ to 4 hours in only 2½, producing fewer rejects and substantial savings in grinding time as well.

Simply by making up self regulating high speed Unichrome Chromium Plating solution, tanks used formerly for the ordinary solution can do more work.

EASY OPERATION

Because important constituents of Unichrome SRHS Baths are automatically controlled, operation is easy and dependable. The SRHS wide bright plate range avoids "burns" and "misses" on the work. These and other advantages are more fully discussed in Bulletin SRHS-2. Send for it.

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Branch News

ALLENTOWN-READING BRANCH

The final and most important meeting of the season was held on May 19 at Scotty's Anchorage, Emmaus, Pa.

The meeting concerned one of the most important phases in the electroplating field. It was a round-table discussion on cleaning and metal preparation prior to plating. A panel of experts was present, representing the leading manufacturers of cleaning materials. Some of the topics covered were: (1) advantages and disadvantages of alkaline-immersion cleaning prior to electrolytic cleaning; (2) when and how to use a solvent-emulsion presoak; (3) can vapor-degreasing be eliminated by immersion cleaners; (4) removal of buffing compound residues; and (5) paint and lacquer stripping.

W. E. Walter, Jr., *Librarian*

BOSTON BRANCH

At the June 3rd meeting held at the Hotel Statler, Boston, the speaker was Richard C. Barrett, President, The Barrett Chemical Products Co., Inc. of Shelton, Conn. His subject was "Nickel Plating from a Sulfamate Solution."

Particular interest has been developed in the publishing field with this solution, and it has been accepted readily in the electrotyping industry over other nickel solutions. It has indications of expanding to other fields.

As usual, the branch played host to its membership. Coffee, cokes, beer and sandwiches were served after the meeting.

George P. Swift, *Secretary*

BRIDGEPORT BRANCH

The May 14th business and educational session was held in the main ballroom of the Hotel Barnum. It was called to order at 8:25 P. M. by the presiding officer, Joseph Simon, 1st Vice-President.

One application for membership was received from R. F. Richards. Three members voted in the branch were: Evan H. Silos, Edward P. Dawber, and John D. Tychanich.

Art McNeill reported that all arrangements for the annual Spring Dinner-Dance had been finalized and that a merry time was in the offing.

The following were appointed to standing committees: Sick Committee, H. Braun, W. Ehrencrona; Publicity Committee, F. Tatum; Projector Committee, G. Eckholm.

Art McNeill was appointed Chairman for the annual picnic and outing.

Librarian F. Tatum introduced the featured speaker of the evening, John Davis of the Udylite Corp. As chief design engineer of automatic equipment, Davis' experience enabled him to present his subject matter in a very interesting manner. The development of automatic equipment was presented by means of a very colorful film showing the various types of equipment in use today and that which is projected for the future. After the film, television of the current fight was available as well as excellent refreshments. A. Ferguson and A. McNeill of MacDermid, Inc., were hosts for the evening.

Bob Parker, *Secretary*

BUFFALO BRANCH

At the May 7 meeting, the chairman of the Picnic Committee, J. Ruff, announced that the annual picnic will be held Saturday, August 14, at the Buffalo Auto Club grounds in Williamsville. The ladies' committee for the educational session and dance on Saturday, October 2, was announced as follows: Mrs. A. Nigro, Chairman; Mrs. J. Moneypenny, Mrs. L. Nowak.

The following were elected for the 1954–1955 year:

President—J. Moneypenny
1st Vice-President—W. M. Fotheringham
2nd Vice-President—A. A. Janis
3rd Vice-President—B. Joffe
Librarian—R. Hoffman
Secretary—E. G. Sampson, Jr.
Treasurer—R. Campbell
Sergeant-at-Arms—F. Rudolph
Board of Managers—A. Nigro, L. Nowak, L. Davis

Named delegates to the convention were: James Moneypenny, W. M. Fotheringham, O. B. Kirchhoff; alternates, L. A. Davis, S. T. Bush, and E. G. Sempson, Jr.

Eric G. Sampson, Jr., *Secretary*

CHICAGO BRANCH

About 60 members turned out on May 14 to hear Dr. F. A. Lowenheim of the Metal and Thermit Corporation speak on the deposition of tin alloys.

At the business meeting, the group voted to contribute $150 to the John Crerar Library for the purchase of publications in the field of electroplating. The group also discussed the coming convention in New York. In addition, the Branch exhibits committee for the convention was appointed.

After dinner, the group adjourned to the auditorium to hear Dr. Lowenheim.

The speaker stated that, generally speaking, "Mr. Electroplater" will be faced more and more with the problem of alloy deposition because alloys, as a general class, have more desirable properties than the pure metals of which they are composed. While alloy baths are slightly more complex and controls are more difficult, Dr. Lowenheim feels that the properties of the alloy deposit are sufficiently desirable to make the additional effort worthwhile.

Discussed were the following tin alloys: lead-tin, copper-tin, tin-zinc and tin-nickel. He gave baths for each and outlined the principal variables and their control and also exhibited sample parts plated in the various baths which he had described.

After the talk and discussion period, a film describing automatic plating machines and their construction, furnished by The Udylite Corporation, was shown.

The Branch extends a cordial welcome to the following new members: C. W. Jordan, Jr., Illinois Tool Works; Robert G. Beaman, Dearborn Chemical Company; Milton C. Johnson and Emerich Bechtold, Illinois Tool Works.

Jerome Kuderna, *Publicity*

CINCINNATI BRANCH

The last meeting before the summer vacation period was enjoyed by 26 members and guests. President William Gordon presided.

Gordon announced a change in the Delegates and Alternates to the National Convention with the final list as follows:

Delegates: R. D. Miller, L. A. Critchfield and W. Young.

Alternates: W. D. Gordon, R. A. Barry and C. Truman.

Ezra Blount began discussion of necessity of making a good effort on part of all delegates to National Convention toward lining up support for 1958 Convention at Cincinnati. A committee was appointed as follows: Chairman, L. A. Critchfield, Ezra Blount, Charles Wise, Will Loveless, Wm. Young and John Magly.

Wm. Young was asked to represent the chapter at the Secretaries' Luncheon, at the Convention. Gordon appointed C. R. Sorber as a second representative with himself to the Technical and Scientific Societies Council, governing body of the Engineering Society. After the business meeting, a timely and interesting movie, "Clean Waters," was enjoyed.

Speaker for the evening, Edward I. Peters, of Process Engineering Co., Skokie, Ill., gave a most interesting talk on the "Barrett Sulfamate Nickel Plating Process." The paper was well organized; covered the history of the process, its initiation in the printing field, its modern applications, bath composition, and characteristics. Some of the outstanding features claimed were: (1) extreme low stress of deposit; (2) exceptional hardness with ductility, and control of same; (3) simplicity of control; (4) stability of bath.

The talk was illustrated with slides. After the adjournment, the usual Social Hour was sponsored by Ruco, Inc., and Rack Processing Co.

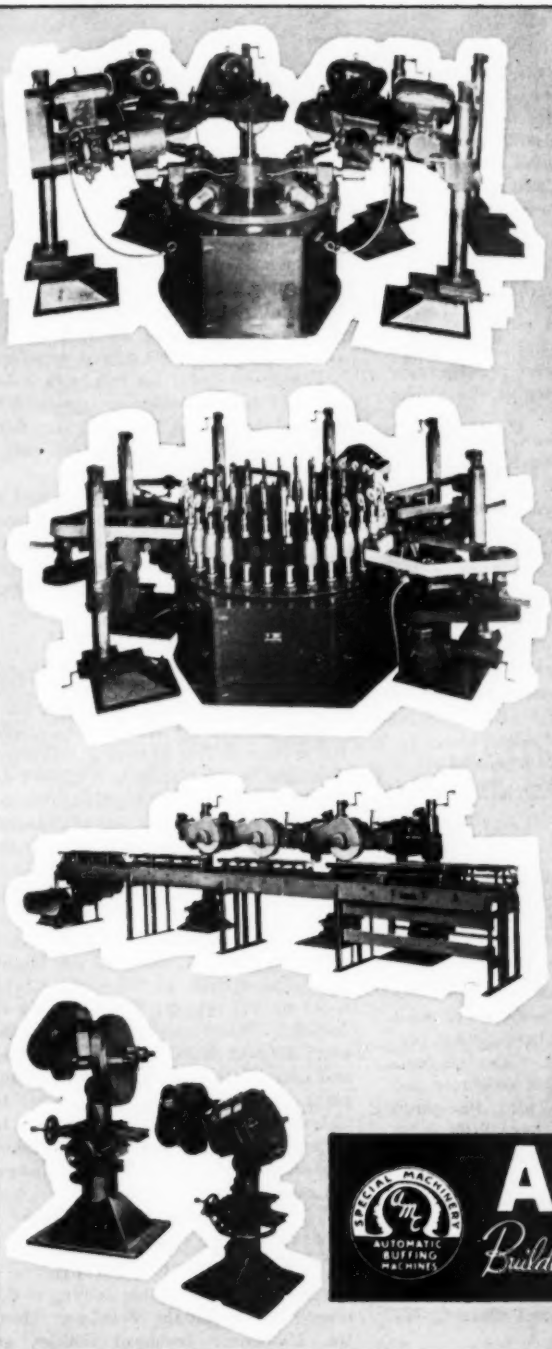
L. J. Howald, *Secretary*

CLEVELAND BRANCH

The April 7 meeting was held at the Hotel Carter. Speaker of the evening was to have been H. P. Heil of the Heil

ACME *Automatic*
POLISHING *and* BUFFING MACHINES

are engineered for low cost, high production finishing...



- For Polishing and Buffing, De-burring, Wire Brushing and Micro-finishing
- Rotary *Automatics*
  Straightline *Automatics*
  Semi-Automatics
- Backed by half a century of specialized experience and progressive development
- Proved performance and dependability in industry

RECOMMENDATIONS and QUOTATIONS

• We will be pleased to receive blue prints or preferably finished and unfinished samples of the part you contemplate finishing together with detailed information on present finishing operation and production requirements. On receipt of samples and data we will offer recommendations and quotations.

ACME *Manufacturing Co.*

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Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR NEARLY HALF A CENTURY

CATALOGS ON REQUEST

Process Equipment Corp., but due to his sudden illness he was not able to be present. His talk was presented by ROBERT PETERS, a member of the same organization; he gave an excellent discussion of "Materials for Construction of Equipment Used in Plating Operations."

A brief business session was held after the talk; applications from 2 new members were read and accepted, and GENE COMNS gave a brief report for the 1955 annual convention committee.

E. J. ROEHL, *Librarian*

DAYTON BRANCH

The branch held its last meeting of the fiscal year on May 12 at the Biltmore Hotel with 31 present. Nominating Committee Chairman, HERMAN AUSTEN presented nominees to be elected at this meeting. Elected were:

President—JOHN EASTON
1st Vice-President—RALPH COLLINS
2nd Vice-President—ROBERT RULEFF
Secretary—RICHARD CLINEHENS
Treasurer—JACK BAKER
Board of Managers—RICHARD CLINEHENS, FRED BAUCH, RALPH CLINEFELTER
Librarian—HOLLE LUECHAUER

Speaker for the evening then was introduced, DR. LOUIS WEISBERG, who gave a most interesting paper, "Recovery of Cyanide Plating Wastes." Four Columbus AES members, representing Westinghouse Electric and one member came all the way from Mansfield to hear this paper given. Refreshments were then served through the courtesy of the Branch.

RICHARD CLINEHENS, *Secretary*

DETROIT BRANCH

The May 7 meeting was held at the Hotel Statler. About 200 were present at this last meeting of the season. The first meeting of the fall season of 1954 will be held on September 10, in the same location.

JOE GURSKI presided during the meeting when 11 new applications for membership were voted into the branch. Membership now exceeds 615 members.

It was mentioned and passed by the members that the Detroit Branch would incorporate. Delegates to the National Convention will go uninstructed.

GLEN FREIDT, JR., reported on the possibilities of having the National Convention in Detroit in 1959. Ample hotel facilities, a convenient location near the new auditorium that could house the IFE if held in Detroit are features that permit the branch to make an attractive bid for the 1959 Convention.

After the showing of a Disney film on aviation, FRED OLMSTEAD, Educational Chairman, presented the guest speaker of the evening, RAY W. REDMOND, Production Engineer, Oldsmobile Division of General Motors Corp., who spoke on "Prefinishing of Steel Prior to Electroplating." The talk centered around the usage of abrasive belts, and particularly emphasized polishing the flat, prior to forming operations. Profilometer curves were projected showing scratch patterns and of back stand belts, from 100 grit through 320 grit both with aluminum oxide and silicon carbide grain.

A second series of projections illustrated polish line patterns from 80 microinches down to 5 microinches.

As stated in the talk, "the finish is no better than the base started with," regardless of part being worked on. Taking nothing away from the development of bright plating to obtain full benefit of these plating processes, it still remains essential to have an intelligent and factual approach to base metal preparation. Redmond concluded that, with this in mind, minimum deposition can be applied with maximum in corrosive resistance and a resultant better job.

JOHN DRINKWATER, *Publicity*

GRAND RAPIDS BRANCH

The branch had an excellent turnout for its last meeting of the current season, May 7; 96 members were present to enjoy a fine social evening at the University Club.

A cocktail hour before a dinner of steak and shrimp was followed by entertainment by the Swanson Boys, who with electric guitars, bass viol, and harmonious voices, put on a fine performance.

PRESIDENT CARL GREEN then gaveled the meeting to order. Two applicants were accepted as new members: CHESTER LOMASIEWICZ and WILLIAM MOONEY of Furniture City Plating Co.

LIBRARIAN TOM HENNER opened the discussion session by introducing the following board of experts:

C. BERRY, Maas & Waldstein Co.
C. BORLET, McGean Chemical Co.
J. HART, Hanson-Van Winkle-Munning Co.
C. W. OSTRANDER, Allied Research Products, Inc.
R. RACINE, Wyandotte Chemicals Corp.

One question fired at the experts was whether they knew of a cyanide nickel plating bath. No definite answer was given.

Ostrander discussed the merits of chromate versus phosphate coatings as a paint base. He felt that phosphate coatings produce the best paint base. Chromate coatings give better corrosion resistance and are a good base for paint also. Phosphate coatings in themselves have little value for corrosion protection unless they are oiled or painted.

Ostrander noted that his Company has a drop test solution for checking the chromate film thickness on aluminum.

MAURICE CALDWELL asked if anyone knew of a commercial chromium bath that was about 33 per cent efficient. No one knew of such a bath.

Next, the group discussed use of diaphragms in nickel baths. Discussion on the subject was rather contradictory.

The subject of cast versus rolled carbon nickel anodes also was discussed. Consensus was that they could be used interchangeably as there wasn't too much difference in performance in modern chloride containing baths.

After the attentive "Round-Table Discussion" members were the guests of JACK "DUSTY" RHOADES of Northwest Chemical Co., whose graciousness capped a very fine evening.

KENNETH HAMPEL, *Publicity*

JACKSON-LANSING BRANCH

The May 11th meeting was held at the Meadow Lark Inn, Jackson, Mich.; the largest group of the season was present.

DR. SALTONSTALL of the Udylite Corp. was the speaker of the evening. He recently returned from a trip to England, where he attended the 4th International Conference on Electrodeposition. A very interesting talk held the interest of the group in which descriptions of English plating practices were given and methods of talks at conventions were presented.

Saltonstall ended his talk with a few personal stories covering experiences both in England and in Paris, making those present feel that such a trip and experience should be in order for all.

The branch again wishes to extend its thanks and appreciation to the friends from Udylite Corp. for the courtesies extended.

R. W. BOOS, *Publicity*

MELBOURNE BRANCH

A good attendance was recorded at the 84th regular meeting held at the Melbourne Technical College on March 18.

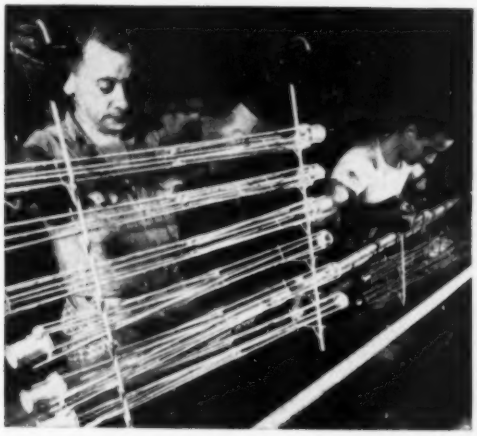
High lights of the business session were the election of BOB LENNIE as Secretary-Treasurer, and a lengthy and spirited debate on whether or not the branch should publish and distribute a list of addresses of its members. The voting favored the affirmative. The meeting was pleased to welcome home HERBERT LITTAUER after his rapid business trip to Europe.

The address for the evening was given by A. F. DUNBAR, Head of the Metallurgy Department at the College, who spoke on the subject, "The Working of Metals." Numerous slides illustrated the many different methods of working metals, and microphotographs showed the effects on the metal structure. Of interest to platers was the description of defects in castings which persisted through various stages of fabrication to remain as potential causes of trouble in plating.

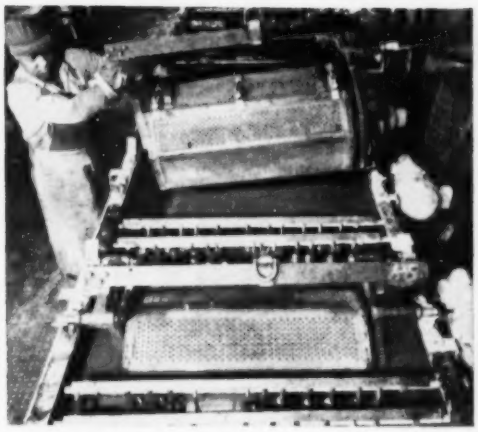
J. J. DALE, *Correspondent*

MELBOURNE BRANCH

The eighty-sixth regular meeting of the branch was held at the Metallurgy Theatre, Melbourne Technical College, on



Cadmium plating umbrella frames. One large job plater turns out as much as 200,000 lbs. of work a day and reports, "No operating troubles in 27 years of plating with 'Cadalyte' cadmium plating materials."



Zinc plating steel casters. One of the world's largest manufacturers of casters uses "Zin-O-Lyte" zinc plating chemicals to plate a thousand different parts. They get bright, uniform results directly from the bath—without bright dipping!

Why "Cadalyte" and "Zin-O-Lyte"

(CADMIUM PLATING CHEMICALS) (ZINC PLATING CHEMICALS)

Produce Bright, Uniform Plating

"Cadalyte"* is the complete plating salt containing all the chemicals you need for lustrous cadmium deposits of any required thickness.

A "Cadalyte" bath has excellent throwing power and high cathode efficiency. This assures you consistently bright cadmium deposits of high uniformity directly from the bath. And because the "Cadalyte" bath is easily operated and maintained, production is simplified.

While designed for the preparation of new baths, "Cadalyte" cadmium plating salt is equally effective in replenishing the metal content of existing baths. And you can easily maintain the high covering power of the bath at its peak by using "Cadalyte" Brightener.

"Zin-O-Lyte"* zinc plating chemicals are specially prepared to give you brilliant rust-resistant zinc deposits directly from the bath—*without bright dipping!*

"Zin-O-Lyte" zinc plating baths are easily made up from prepared salts . . . have excellent operating efficiency at both high and low current densities. Economical to maintain, these baths are effective for all types of zinc plating, but are particularly effective for barrel plating. And you can get bright, blue-white zinc deposits on parts of all shapes and sizes.

So for high quality zinc plating results, at a low cost—use "Zin-O-Lyte". You'll find that you can save time and labor over any plating range.

*REG. U.S. PAT. OFF.

Du Pont plating chemicals are available for practically every cyanide plating requirement. Your Du Pont representative will be glad to help you select the right one for your plating job. For prompt advice on plating chemicals or problems, contact your nearest Du Pont district office.

DISTRICT OFFICES:

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Chemicals • Processes • Service

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BETTER THINGS FOR BETTER LIVING

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E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Dept. P-84, Wilmington 98, Del.

Please send me more information on Du Pont Plating Chemicals—properties, advantages and recommended procedures. I am interested in the following types of plating:

☐ Cadmium Plating ☐ Tin Plating
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Sel-Rex Bright Gold Process

has become

THE NEW "GOLD STANDARD"

- It requires no scratch brushing or buffing for a mirror-bright finish.
- Its greater throwing power gives more protection with less gold.
- It gives 40% more resistance to wear and abrasion.
- Directly over steel, it gives six times greater protection with ¼ the amount of gold, in salt spray tests under standard ASTM conditions.
- It is twice as hard as conventional gold plating.
- It does not alter or deform surface contours because of smoothness of deposit.

Sel-Rex Bright Gold solution is easy to maintain, and operates at room temperature. No special equipment is required. Hundreds of successfully operating installations, both decorative and industrial, have proven the superiority of the new Sel-Rex Bright Gold Process.

SEL-REX PRECIOUS METALS, INC.

229 MAIN STREET • BELLEVILLE 9, N. J.

PRECIOUS METALS SALTS AND SOLUTIONS FOR THE PLATING INDUSTRY

Branch News

Thursday, May 20 with PRESIDENT J. PARKER and 40 members and visitors present.

The resignations of five members were accepted.

LIBRARIAN TEAGUE introduced the speaker of the evening, H. LITTAUER, who discussed his recent visit to England and the Continent. His talk was entitled "Impressions of Overseas Metal Finishing Plants" but this proved rather misleading as he had been concerned primarily with anodizing.

Littauer found a very high spirit of cooperation extended to him by members of the Institute of Metal Finishing. It was discovered that in England, traditional methods are still being used in preference to modern methods, in the majority of factories.

After leaving England, Littauer visited Brussels, Paris, Germany and Switzerland. In these places four visits were made daily to various anodizing plants. The best standard of work was being produced by those places where extra-high purity aluminum (99.99 per cent) was being employed. Some new proprietary methods were observed—one very remarkable instance was related, where time, temperature, current density and purity of aluminum were of no consequence so long as the additional agent was present, with the obvious results.

On the continent, Littauer noticed a definite increase in the use of anodized aluminum and alloys in buildings, both structurally and in the finishing.

Various samples were exhibited, questions were asked, and the meeting closed after a very enjoyable and informative address.

JOHN J. DALE, *Secretary*

MILWAUKEE BRANCH

Four aspects of metal finishing in today's competitive market were discussed at the annual meeting of the branch on April 24, 1954 at the Schroeder Hotel, Milwaukee.

A. M. LINN of United Chromium, Inc., discussed "Bright Nickel Plating." He reviewed the general characteristics, cited recent process improvements and described some operating characteristics of bright nickel plating solutions.

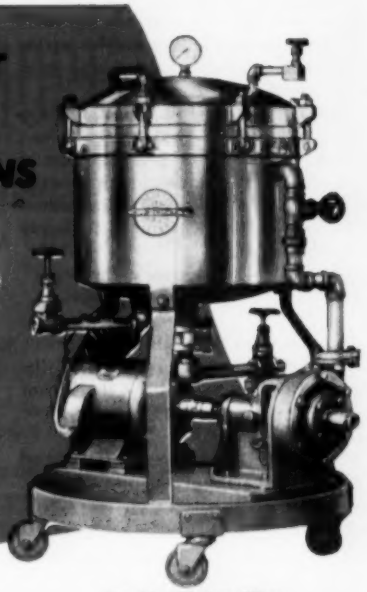
C. O. HUTCHINSON of the Nubian Paint Division of the Glidden Co., discussed "Organic Finishing," covering in some detail two possible fields of cost reduction through the use of modern application methods.

K. M. HUSTON of the Armco Steel Corp. discussed the role of "Stainless Steel." While unable to review all of the factors in the short time allowed, he outlined many of the factors to be considered in the finishing of the stainless steels.

R. A. FELLOWS of the Udylite Corp.

FOR LOW COST FILTERING OF PLATING SOLUTIONS

SPARKLER HORIZONTAL PLATE FILTERS



Sparkler Plating Filter
Model 18-D-6 Alliron
600 G.P.H. Portable

HERE'S HOW

★ On a horizontal filter plate it is possible to apply a thin pre-coat with about one-third the filter aid, and in one-third the time required for pre-coating a non rigid media or a surface in a vertical position. This saves time and filter aid.

★ With the Sparkler horizontal plate you can apply this thin pre-coat evenly over the entire plate surface and start filtering immediately with less pressure and obtain maximum consistant clarity right from the start up to the end of the cycle.

★ A filter cake on a horizontal plate will not crack, slip or fall off even with varying pressure or a complete shut-down of the filter. No pre-coat renewal is ever required after an interruption in operation.

★ When it is necessary to clean the filter, the Sparkler filter tank can be emptied in a matter of minutes with a minimum of loss of valuable plating solution.

★ Any grade of filter paper from fine to coarse can be used in a Sparkler filter. This makes it ideal for carbon treatment of solutions. Carbon mixed with water in a stand-by tank is circulated through a clean set of filter paper on the plates until a carbon cake is formed. The solution requiring carbon treatment is then circulated through the carbon beds without contaminating the plating tank or a shutdown of plating operations.

★ At the end of the cycle with a Sparkler filter you can blow-down with air and produce a relatively dry cake that can be disposed of in a trash can rather than washing it down the drain with attendant sewer clogging problems.

★ You will find your Sparkler plating filter positive and dependable from a standpoint of uniform high quality filtering and economical in labor and material.

SPARKLER

Sparkler representatives in all principal cities are ready to give you personal service on your filtering problems, and show how you can make a material saving in operating cost.

MANUFACTURING COMPANY
Mundelein, Illinois

Sparkler International Ltd.
Prinsengracht 876, Amsterdam, Holland

Sparkler Western Hemisphere Corp.
Mundelein, Ill. U.S.A.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 981.

assured the listeners that plating could remain competitive in today's market through the use of automatic and semi-automatic machines.

The branch started its educational sessions at 10:00 A.M. and resumed them after a cocktail party and luncheon at noon. At 7:00 P.M., a banquet was served in the Crystal Ballroom to 400 members and guests and gaiety reigned for many hours thereafter.

CLIFFORD A. PETER,
Assistant Secretary

MONTREAL BRANCH

The regular monthly meeting of the Montreal branch was held at the Mount Royal Hotel on Tuesday evening, June 1, 1954.

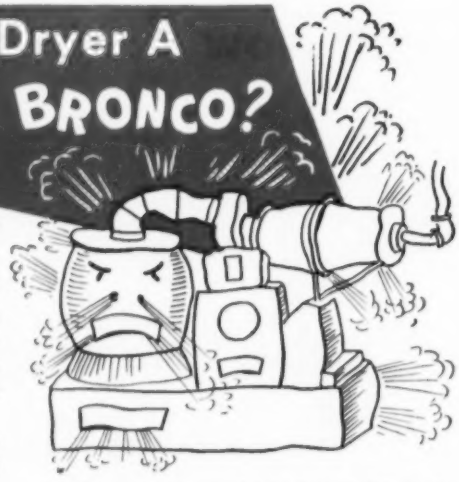
LIBRARIAN RALPH COHEN introduced the guest speaker of the evening, G. GAUCHER, supervisor of production control, at General Electric Co. Ltd., Montreal.

Gaucher's talk discussed the necessity of inventory control in our plants. He outlined such topics as "The Return of Investments," "Costs of Carrying Inventory," "Turnover in Industry," "You Should 'A B C ' Your Basic Tools" and such important factors as obsolete materials, spoilage allowances, standardization, mfg cycle, coordinate changes, economic lot size. He concluded his talk by saying, "You are in a much better position with your competitors if you have an inventory control."

During the business session it was voted to have a regular annual banquet instead of a dinner dance. J. P. COURTEMANCHE appointed J. J. ROCHE, chairman, and J. D. FAIRBAIRN, cochairman of the AES Convention to be held in Montreal in 1957.

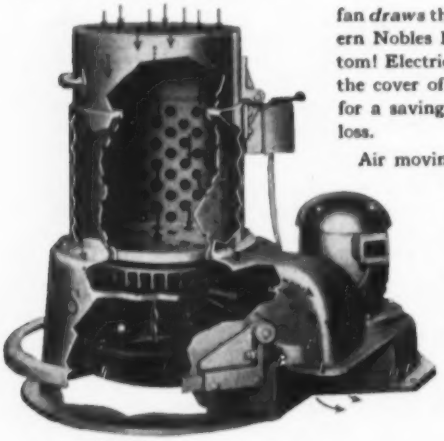
JEAN MONETTE, *Secretary*

Is Your Dryer A
BUCKING BRONCO?



In order for a centrifugal dryer to stay put it should be heavy. That's why the modern Nobles Dryer is about twice the weight of most dryers. Extra weight is one of the reasons for its stability, its freedom from vibration, its smooth operation, and long trouble-free life.

It's all new in design and principle. A powerful suction fan *draws* the air completely through this modern Nobles Dryer and exhausts it at the bottom! Electric or steam heaters are mounted in the cover of this machine of advanced design for a saving of space and elimination of heat loss.



Air moving equipment isn't an extra. The powerful suction fan is an integral design feature of each machine. A brake pedal extending around the entire work area controls an internal, expanding hydraulic brake for quick, smooth stops.

Why not take the first step now toward modern quick drying and lowest costs?

NOBLES ENGINEERING & MANUFACTURING CO.

Write Today for the FREE NOBLES DRYER BROCHURE

NEWARK BRANCH

The May 21st meeting was held at the Robert Treat Hotel, Newark, N. J. The meeting was called to order by PRESIDENT JOHN GUMM, following the regular Dutch treat dinner and presentation of a film by HOWARD COBB.

Applications from J. RICHARD RELICK and ALBERT H. CAPO were referred to the Board of Managers; FLAVIO J. LA MANNA and MALCOLM L. PARKERTON were elected to membership.

GUS BITTRICH reported the exhibit for the New York Convention as well along but asked if anyone could prepare samples of osmium, iridium or ruthenium plating.

LIBRARIAN CLIFF STRUYK then introduced ZACHARY IRENAS to the 42 members present. He discussed the use of black oxide finishes on steel, describing the reaction, bath composition and uses of this finish. The cost is not much less than cadmium or zinc, the corrosion resistance is not as good and the process is less pleasant to run.

F. P. SPRUANCE of American Chemical Paint Co. then presented a paper on "Chemical Treatments for Aluminum." He described such finishes as being required both for paint adhesion and improved corrosion resistance. The speaker described a new colorless coating, Alodine 1000, weighing less than 3 milligrams per square foot, which overcomes some of the aesthetic disadvantages of colored coatings.

D. GARDNER FOULKE,
Recording Secretary

NEW YORK BRANCH

At the May 14th meeting held at the Hotel Statler, New York, PRESIDENT AMATORE announced the presence of the following out-of-town members: F. EDDY of the Waterbury Branch and L. GLASSNER of Chicago. Glassner announced the date of the annual meeting of the National Federation of Metal Finishers which will be held in New York City July 13, 1954.

PETER VEIT then presented G. HERRMANN of S. W. Farber, Inc., and Past President of the New York Branch.

Herrmann's subject for the evening was "Plating on Lead Alloys" and was well received.

LESTER LEVINSON,
Recording Secretary

PITTSBURGH BRANCH

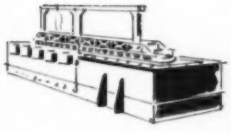
At the April 7th meeting two new members were welcomed into the branch. They were JOHN K. SARGENT and GRANT N. BRUNDAGE. The application of ALEXANDER HAYS, III, also was received for membership.

GERRY LUX of Oakite Products was the speaker of the evening. His subject, "Fundamentals of Alkaline Cleaning," was put across most ably with a fine talk and clever use of many bottled solutions for demonstration purposes.

LIBRARIAN FRED DIXON presided over

WORLD LEADERSHIP IN 10 SHORT YEARS!

Simplicity of design, durability of construction and the economies of accurate plating have built Udylite leadership in automatic plating equipment in a decade



Yes, it was only ten short years ago that Udylite delivered its first hydraulic fully automatic plating machine. Since that time Udylite sales of equipment have mounted each year until today Udylite machines are in use in every country in the world where manufacturing in metal is important. In fact, the deliveries of Udylite plating machines in 1953 reached an all time high, and repeat orders were an important factor in this record.

Ingenious engineering is one of the reasons behind the Udylite success story. Many Udylite machines have been in operation for 24 hours a day, seven days a week for years. And all of this performance with practically no replacements. In fact, the recommended *spare part list for the Udylite machine totals less than one hundred dollars.*

Udylite machines are being used today in plating hundreds of different products . . . from small telephone relays to bulky tubular furniture, and for almost as many different processes.

The Udylite Full Automatics engineered and built to suit the need have ranged in size from 20 feet to 500 feet in length. Udylite can furnish a machine for every plating or finishing problem.

If you have a metal finishing production problem, Udylite Full Automatic Equipment can help you.

Official inspection of Udylite's 600th Full Automatic, 100 feet long, built to copper, nickel, chrome plate 3,000 cigarette lighters per hour.

Write for the booklet "Udylite Automation in Plating"— the story of Udylite Full Automatics in industry today

IS A
PLA-TANK® STACK
THE ANSWER
TO YOUR
FUME PROBLEM?

Shown here is a light-weight, easily-erected PLA-TANK stack which handles fume exhaust at the new thorium plant of the Lindsay Chemical Co., West Chicago, Ill.

The stack has a 44" diameter, is 69' long including 90° elbow, cross run to fan chamber and riser beyond fan. There are inlets from three floors to handle exhausts from individual tank systems. Stack was prefabricated with flanges for fast installation.

PLA-TANK STACKS may also be the answer to your problem of venting corrosive fumes — inside or out. Consider these many advantages

- . . . manufactured from long-life, resin-bonded glass fiber laminate
- . . . resistant to a wider variety of fumes and temperature than ever before
- . . . not affected by extremes in weather
- . . . light weight, easy to install; need less rigging and support; save handling, freight, shipping charges
- . . . competitively priced; available in diameters to 60"

Let us help you solve your problem the modern way — with PLA-TANK STACKS. Write today for free data sheets.

P-20

THE Chemical CORPORATION
57 Waltham Ave., Springfield 9, Mass.

Branch News

a lively discussion period devoted to practical problems in cleaning encountered by the members.

HARRY FLISTER, Annual Banquet Chairman, reported the banquet, attended by 248 members and guests, was a big success.

I. H. SCHRAM, *Secretary*

PROVIDENCE-ATTLEBORO BRANCH

The April 19th meeting was held at the Providence Engineering Hall with 27 members and guests present.

PRESIDENT P. LONSBURY appointed JOHN HENRY to plan the Spring Frolic which is held in Attleboro every spring. The annual reports of the president, secretary and treasurer were read and accepted. The following were elected as delegates to the National Convention: LESLIE FERGUSON, EDWARD PARKER, JOHN P. CLARNER; and alternates, GEORGE E. GIBBS, EDWARD GARABEDIAN, SAMUEL COURCY.

Guest speaker of the evening was WILLIAM H. GANNON who chose for his subject, "Aspects of Refining." Gannon has been in the refining business for 34 years and now is part owner of Gannon and Scott. He described in great detail how gold is refined and the method used in figuring the cost of the operation and the net return to the customer. As to be expected, the subject was appreciated greatly by everyone as many in this area send out gold to be refined.

HENRY SHAVIER, *Secretary*

SAN FRANCISCO BRANCH

At a special meeting held prior to the regular monthly meeting, PRESIDENT EDWARD KETTMAN appointed a Membership Committee and an Attendance Committee.

Those present were: EDWARD KETTMAN, J. R. PATTENGER, JACK ULRICH, FRED W. HUNTINGTON, FLOYD W. BROWNING.

The following were appointed to the Membership Committee: J. R. PATTENGER, FRED HUNTINGTON, FLOYD BROWNING, HOWARD LACKEY, JR., and the following members were appointed to the Attendance Committee: ROBERT HART, MARK CROW, BERT TRYGSTAD, RAY HEFNER, and JACK ULRICH.

The regular May 13th meeting was held at Larry's Restaurant, San Francisco.

Due to a sudden illness, the scheduled speaker was unable to attend. JACK RASKIN of the L. M. Butcher Co., and Fred Huntington, Consultant for the San Francisco area, substituted for the regular speaker.

Raskin pointed out the tremendous problems the nickel shortage has placed on the plating industry, with no immediate relief in sight. He also elaborated on such subjects as automatic plating, abrasive tumbling and high-speed nickel baths. With Huntington and Raskin as moderators, there was an open discussion on the use of PR units in nickel baths, and the use and importance of EP tanks, nickel storage tanks, problems with undercoatings on bumpers, and the use of polysulfide for purifying zinc solutions.

FLOYD W. BROWNING,
Secretary-Treasurer

SOUTHEASTERN BRANCH

A regular meeting was held at the Belmont Steak House on May 14. After the usual dinner, the meeting was called to order by PRESIDENT R. C. STEFFEY, with 12 members and guests present. Three new members were elected: RICHARD R. RUSSELL, Udylite Corp.; FRANK N. YOUNG, Stainless Metal Products, Chattanooga, Tenn., and R. E. NORMAN, of Bonner Spring Hinge Co., Landrum, S. C.

The branch Ladies' Night was discussed, and it was decided that it would be in the form of a dinner-dance, to be held on Saturday, August 14 at $10 per couple. Guests are cordially invited. The committee consists of CLEM HOHNER, CLYDE STOVALL, and H. R. STOGNER; all arrangements as to location, entertainment are being handled by the committee.

Then C. Hohner came up with a "question-and-answer" program which was not only interesting, but also profitable. Hohner, Stogner and Angier were to answer the questions, each time they failed it cost them $1. The branch collected $6. The meeting adjourned at 10:30 P.M.

W. T. WEYMOUTH,
Secretary-Treasurer

WATERBURY BRANCH

The May 13th meeting was held in the Colonial Room of the Hotel Elton. After a dinner preceding the meeting, PRESIDENT PERRY SLOANE opened the meeting promptly at 8:00 P.M. A motion was made and carried that for the 1954–1955 period, the regular branch business meeting be held at 7:00–8:00 P.M. preceding the regular monthly technical program. A dinner from 6:00–7:00 P.M. will precede the business meeting.

TECHNICAL CHAIRMAN HARRY HAINES then introduced DR. GEORGE DUBPERNELL, who gave a brief review of two books on detergency. Following the showing of a movie entitled "Housatonic Valley," Haines turned the meeting over to the speaker of the evening, LLOYD OSIPOW, Research Director, Detergent Section, Foster D. Snell, Inc. Osipow briefly discussed the role of anionic, nonionic and cationic surfactants in aqueous solutions. Data were shown to indicate that increasing molecular weight increases the wetting ability of surfactants.

After a brief question-and-answer period, the meeting adjourned at 10:00 P.M.

WILLIAM P. INNES,
Publicity Director

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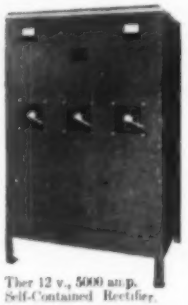

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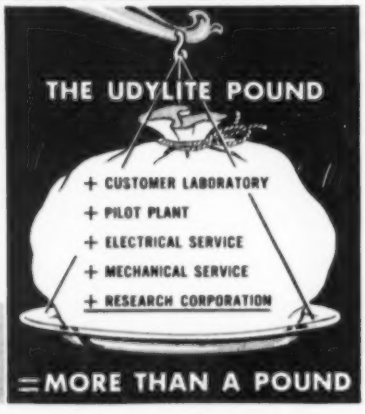

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Lehigh University, Bethlehem, Pa.
Secretary.....The Executive Secretary

ADELAIDE, AUSTRALIA meets second Wednesday of each month. Secretary, R. J. Down, Room 30, 17 Currie Street, Adelaide, S. A., Australia.

ALLENTOWN-READING meets third Wednesday of each month in Scotty's Anchorage, Second and Main Streets, Emmaus, Pa. Secretary-Treasurer, Edgar H. Iobst, Jr., 163 Main Street, Emmaus, Pa. Research Finance Committee Chairman, Lee C. Wotring, 526 N. St. Elmo Street, Allentown, Pa.

BALTIMORE-WASHINGTON meets second Tuesday of each month with meetings in Baltimore at the Engineers' Club and in Washington, D. C., at the National Bureau of Standards. Secretary, Carl H. Thiede, 8426 Piney Branch Road, Silver Springs, Md.

BOSTON meets first Thursday of each month in Hotel Statler. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown 72, Mass. Research Finance Committee Chairman, Louis V. Gagnon, 53 High Street, Natick, Mass.

BRIDGEPORT meets second Friday of each month in Barnum Hotel. Secretary-Treasurer, Robert G. Parker, 25 Beverly Road, Trumbull 58, Conn.

BUFFALO meets first Friday of each month in Markeen Hotel. Secretary Eric G. Sampson, Jr., 43 W. Main Street, Falconer, N. Y.

CAPITOL DISTRICT BRANCH. Regular meeting date to be announced. Secretary, P. D. Callahan, 1855 Becker Street, Schenectady 7, N. Y.

CHICAGO meets second Friday of each month at 6 P. M. at Western Society of Engineers, 84 E. Randolph Street. Sec

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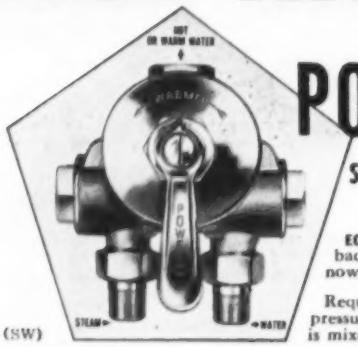

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CINCINNATI meets fourth Wednesday of each month at 7:30 P. M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary, William Young, 7124 Montgomery Road, Cincinnati 36, Ohio. Research Finance Committee Chairman, C. R. Sorber, 2004 Connecticut Avenue, Cincinnati 24, Ohio.

CLEVELAND meets first Friday of each month in Hotel Carter at 8 P. M. Secretary-Treasurer, A. J. Lupien, 4408 Carnegie Avenue, Cleveland 3, Ohio. Research Finance Committee Chairman, to be appointed.

COLUMBUS meets first Friday of each month at 8 P. M. in Battelle Memorial Institute Auditorium. Secretary-Treasurer, Harry L. Moore, 505 King Avenue, Columbus 1, Ohio. Research Finance Committee Chairman, to be appointed.

DALLAS-FORT WORTH: Secretary-Treasurer, A. C. Fricke, 212 Julien Street, Dallas 8, Texas.

DAYTON meets third Wednesday of each month in the Biltmore. Secretary, Richard M. Clinchens, 33 W. Market St., Germantown, Ohio. Research Finance Committee Chairman, Richard F. Moore, 526 Aberdeen Ave., Apt. B, Dayton 9, Ohio.

DETROIT meets first Friday of each month in Hotel Statler. Secretary-Treasurer, R. J. Racine, c/o Wyandotte Chemicals Corporation, Wyandotte, Mich. Research Finance Committee Chairman, L. M. Morse, c/o Chrysler Corp., Detroit, Mich.

GRAND RAPIDS meets second Friday of each month at Fingers Restaurant at 7 P. M. for dinner; educational session at 8:15. Secretary, John Dykstra, 104 Celia, S. E., Grand Rapids, Mich.

HAMILTON BRANCH meets third Thursday of each month in the Conference Room, West End Plant, Canadian Westinghouse Company, Ltd. Secretary, R. Burke, c/o Swift Devices, 14 George Street, Hamilton, Ontario, Canada.

HARTFORD meets third Monday of each month in Hotel Bond at 7:45 P. M. Secretary, Stanley Platoz, 26 Erwin Place, New Britain, Conn. Research Finance Committee Chairman, Frank W. Smith, 46 Cottage Street, Meriden, Conn.

HOUSTON meets third Tuesday of each month at 6:30 P. M. in the Ben Milam Hotel, Houston, Texas. Secretary-Treasurer, Forest Baskett, 1240 Overhill, Houston, Texas.

INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 E. Washington Street. Secretary, Miss Edna Rohrabaugh, 816 Robert Street, Lafayette, Ind.

JACKSON-LANSING meets second Tuesday of each month alternating between Meadow Lark Inn in Jackson and Porter Hotel in Lansing. Secretary-Treasurer, E. J. Bosca, 411 Third Street, Jackson, Mich. Research Finance Committee Chairman, H. McKlueen, 3617 McCain Road, Jackson, Mich.

KANSAS CITY meets fourth Thursday of each month at Roselli's Restaurant at 6:30 P. M. Secretary, Olin K. Bock, 5317 W. 58th Street, Mission, Kans.

LANCASTER meets second Friday of each month at 8 P. M. September, December and April meetings are held at Hanover, York and Harrisburg, respectively; all other meetings at the Old Mill Inn, Lancaster, Pa. Secretary-Treasurer, Harry A. Saylor, 40 N. Poplar Street, Elizabethtown, Pa. Research Finance Committee Chairman, Harry Hovis, Lincoln Highway, West Lancaster, Pa.

LOS ANGELES meets second Wednesday of each month at 6:30 P. M. in Rodger Young Auditorium. Secretary, Norman K. McEwan, 5701 West Century Blvd., Los Angeles 45, Calif. Research Finance Committee Chairman, Earl Coffin, 5102 Marburn Avenue, Los Angeles 43, Calif.

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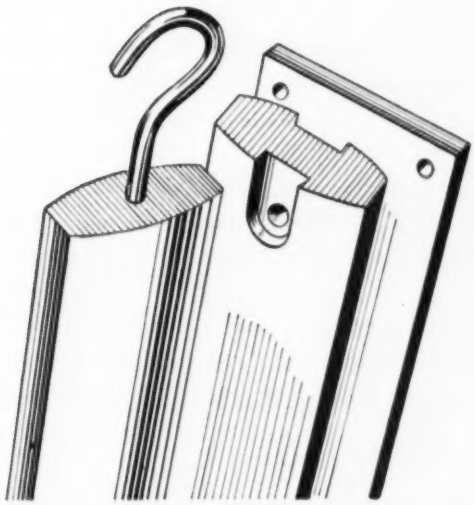

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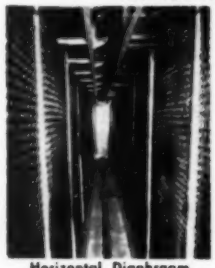

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LOUISVILLE meets third Thursday of each month in Room 119, Speed Scientific Building, University of Louisville. Secretary-Treasurer, Joseph G. Sterling, 1169 Keller Avenue, Louisville, Ky. Research Finance Committee Chairman, T. K. Allison, 2502 Manchester Rd., Louisville 5, Ky.

MELBOURNE, AUSTRALIA meets third Thursday of each month at 8 P. M. in Metallurgy Theatre, Melbourne Technical College, 124 Latrobe Street. Honorary Secretary-Treasurer, S. B. Pearce, 11 Waterloo Street, Carlton, Melbourne, Australia.

MILWAUKEE meets first Friday of each month in the East Room, Hotel Ambassador. Secretary-Treasurer, Clifford A. Peter, West Allis 14, Wis. Research Finance Committee Chairman, to be appointed.

MONTREAL meets first Tuesday of each month in Mount Royal Hotel. Secretary, Jean Monette, Montreal, P. Q., Canada. Research Finance Committee Chairman, P. M. Coady, c/o Alloycraft, Ltd., 27 Hillside Avenue, Westmount, Montreal 6, P. Q., Canada.

NEWARK meets third Friday of each month at 8 P. M. in Hotel Robert Treat. Secretary-Treasurer, George Wagner, Hy-Grade Electro Plating Company, 35 Fourth Street, Newark, N. J. Research Finance Committee Chairman, John Gumm, 538 Forest Street, Kearny, N. J.

NEW HAVEN meets second Tuesday of each month alternating between Sterling Chemistry Laboratory, Yale University, and Hotel Taft. Secretary-Treasurer, B. J. Gaffney, 40 Filbert Street, Hamden 14, Conn. Research Finance Committee Chairman, Dr. H. L. Kellner, c/o Lea Manufacturing Company, 16 Cherry Avenue, Waterbury 86, Conn.

NEW YORK meets second and fourth Fridays of each month in the Statler Hotel. Secretary-Treasurer, George Schore, 150 Bennett Avenue, New York 33, N. Y. Research Finance Committee Chairman, Milton Nadel, 41-15 50th Avenue, Long Island City 4, N. Y.

PHILADELPHIA meets fourth Friday of each month. Meetings are held at the Broadwood Hotel, Franklin Institute or the Engineers' Club. Secretary, I. William Marcovitch, 1302 St. Vincent Street, Philadelphia 11, Pa. Research Finance Committee Chairman to be appointed.

PITTSBURGH meets first Wednesday of each month in the Avon Room of the Sheraton Hotel. Secretary, Irvin H. Schram, Jr., 4782 Delma Drive, Pittsburgh 27, Pa. Research Finance Committee Chairman, S. S. Johnston, c/o Weirton Steel Company, Weirton, W. Va.

PORTLAND. Secretary, K. B. Humphrey, 936 N. E. Floral Place, Portland 31, Oregon.

PROVIDENCE-ATTLEBORO meets third Monday of each month in Providence Engineering Society Hall, 195 Angell Street, Providence, R. I. Secretary, Henry Shavier, 32 Hodges Avenue, Taunton, Mass. Research Finance Committee Chairman, Pierre B. Lonsbury, 78 North Avenue, Attleboro, Mass.

ROCHESTER meets third Monday of each month at the 40 & 8 Club, 933 University Avenue. Secretary, Edwin Wallin, 70 Peach Tree Road, Penfield, N. Y. Research Finance Committee Chairman, Cecil Thornton, 20 Lafayette Parkway, Rochester 10, N. Y.

ROCKFORD meets second Monday of each month in Faust Hotel. Secretary, E. J. Budden, 122 Twelfth Street, Rockford, Ill. Research Finance Committee Chairman, David Stockton, The Udylite Corporation, 1943 Walnut Street, Chicago 12, Ill.

SAGINAW VALLEY meets for dinner at 6:45 P. M. and meeting at 8 P. M. at Zehnder's, Frankenmuth, Mich., second Wednesday of each month, September through May, except February. Secretary-Treasurer, Stewart Harger, 3214 Norwood Drive, Flint, Mich.

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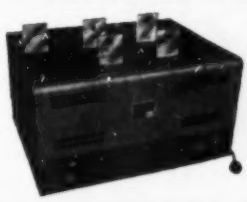

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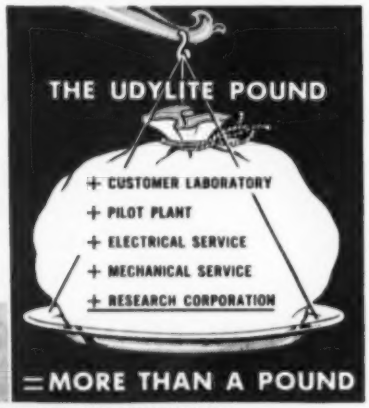

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ST. JOSEPH VALLEY meets first Wednesday of each month at 8 P. M. in Elkhart Hotel, Elkhart, Ind. Secretary-Treasurer, Eugene Roth, 739 N. College Street, South Bend 28, Ind. Research Finance Committee Chairman, Ralph Brouwer, 361 Maple Avenue, Holland, Mich.

ST. LOUIS meets second Wednesday of each month at the York Hotel, 6th and Market, St. Louis, Mo. Secretary-Treasurer, E. R. Hunleth, 4415 Michigan Avenue, St. Louis, Mo. Research Finance Committee Chairman, to be appointed.

SAN ANTONIO. Regular meeting date to be announced. Secretary-Treasurer, Joseph C. Brown, c/o Friedrichs' Refrigerators, Inc., 1117 E. Commerce Street, San Antonio, Texas.

SAN FRANCISCO meets second Thursday of each month, alternating between St. Julien Restaurant, 140 Battery Street, San Francisco, and El Curtola Restaurant, 510 17th Street, Oakland. Secretary-Treasurer, Floyd W. Browning, c/o L. H. Butcher Co., 15th and Vermont Streets, San Francisco, Calif. Research Finance Committee Chairman to be appointed.

SEATTLE. Regular meeting date to be announced. Secretary, Miss Helen Archibald, c/o Electro-Chrome Co., 1324 Dearborn Street, Seattle 44, Wash.

SOUTHEASTERN meets second Friday of each month at the Belmont Steak House, Atlanta, Ga. Secretary-Treasurer, W. T. Weymouth, 173 Clay Street, S. E., Atlanta, Ga.

SOUTHERN TIER. Regular meeting date to be announced. Secretary, Vincent T. Maxian, 3 Wilson Street, Binghamton, N.Y.

SPRINGFIELD meets fourth Monday of each month in the Ivy House, Route 5, West Springfield, Mass. Secretary, Henry L. Heissfeld, 74 Chilson Street, Springfield 8, Mass. Research Finance Committee Chairman, Arthur Pearson, 102 Ely Avenue, West Springfield, Mass.

SYDNEY, AUSTRALIA meets second Thursday of each month at 7:30 P. M. at 155 King St., Sydney. Secretary-Treasurer, M. Taylor, 44 Aubin St., Neutral Bay, N.S.W., Australia.

SYRACUSE meets third Monday of each month in Richard's Restaurant. Secretary, Lindley Wood, 1329 Bellevue Avenue, Syracuse 4, N. Y. Research Finance Committee Chairman, George W. Cavanaugh, 129 Kenwood Avenue, Syracuse 8, N. Y.

TOLEDO meets first Thursday of each month at Park Lane Hotel. Secretary, Gaston Bergeman, 703 Pine Street, Fremont, Ohio.

TORONTO meets second Friday of each month in Royal York Hotel. Secretary, Robert L. Edwards, 1106 Dovercourt Road. Toronto, Ont., Canada. Research Finance Committee Chairman, K. Wells, 370 Victoria Avenue, Toronto, Ont., Canada.

TWIN CITY meets first Monday of each month, October through June, in the Covered Wagon (Lodge Room), 114 S. 4th Street, Minneapolis, Minn., with dinner at 6:30 P. M. and business and technical session at 8:00 P. M. Secretary-Treasurer, Robert L. Buckley, c/o Industrial Chemical & Equipment Company, 205 11th Avenue So., Minneapolis 15, Minn. Research Finance Committee Chairman, to be appointed.

WATERBURY meets second Thursday of each month in Elton Hotel. Dinner, 6:30 P. M.; meeting, 8 P. M. Secretary-Treasurer, Spencer L. Henn, P. O. Box, Drawer B, Chesbire, Conn.

WESTERN ONTARIO meets third Friday of each month in William Pitt Hotel, Chatham, Ontario. Secretary-Treasurer, J. Vollans, 1262 McDougall Street, Windsor, Ontario, Canada.

WICHITA meets fourth Wednesday of each month at 6:30 P. M. at Lydroy's Eighty-one Grill. Secretary, Walter Turner, 423 N. Emporia, Wichita, Kans.

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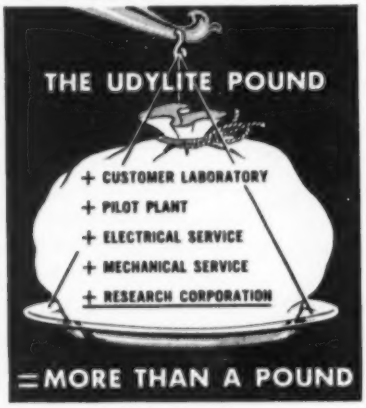

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Future Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting, Milwaukee, on September 8–10, 1954.

METAL POWDER ASSOCIATION, fall meeting, Hot Springs, on September 10–12, 1954.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, national meeting, Hotel Colorado, Glenwood Springs, Colorado, on September 12–16, 1954.

AES RESEARCH COMMITTEE, National Headquarters, Newark, N. J., on September 17, 1954.

SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS, annual meeting, Philadelphia, Pa., on September 21–23, 1954.

ASSOCIATION OF IRON AND STEEL ENGINEERS, 1954 Exposition and Annual Convention, September 28–October 1, 1954—Cleveland Public Auditorium.

PORCELAIN ENAMEL INSTITUTE, annual meeting, White Sulphur Springs, W. Virginia, on September 29–30, 1954.

PLATING EDITORIAL BOARD, Statler Hotel, Cleveland, Ohio, on October 1, 1954.

ELECTROCHEMICAL SOCIETY, fall meeting, Boston, Mass., on October 3–7, 1954.

NATIONAL FOUNDRY ASSOCIATION, annual meeting, Chicago, Ill., on October 6–8, 1954.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS' south central regional meeting, Dallas, Texas, on October 12–15, 1954.

AMERICAN SOCIETY FOR METALS, National Metal Congress and National Metal Exposition, Hotel Statler, Cleveland, Ohio, on October 17–23, 1954.

42ND ANNUAL AES CONVENTION AND 4TH INDUSTRIAL FINISHING EXPOSITION, June 20–23, 1955, Municipal Auditorium, Cleveland, Ohio.

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LEA newsreel

AUGUST 1954

THE LEA METHOD OF FINISHING

The Lea Manufacturing Company pioneered and continues to specialize in the development of CLEAN-WORKING polishing and buffing compositions. These special methods minimize cleaning by employing selected grades of LEA COMPOUND, LEAROK, or other special compositions which virtually eliminate excessive cleaning or hand-scrubbing common with regular heavy grease compounds.

Here are some typical case studies of Lea Methods.

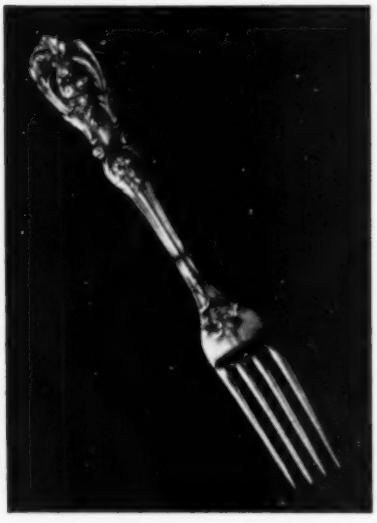
CASE STUDY #1

Material: Sterling silver.

Article: Table flatware.

Method of Forming: Customary for this type of work.

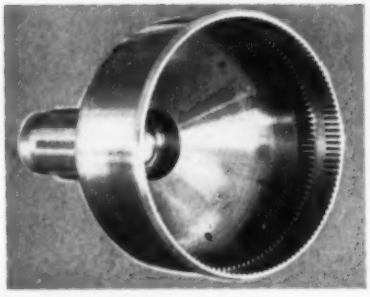
Final Finish: Bright Butler.



Lea Method:

1. Cut-down buffing with Tripoli.
2. Cleaning.
3. Lea Compound Grade A-1 or 5023 on a 6" diameter loose muslin buff at 4400 r.p.m.

Remarks: The Lea Method produces a more pleasing finish in about half the time than that produced by any wet method. When a more pronounced Butler finish is desired, a packed buff with Grade A-63 Lea Compound is used.



CASE STUDY #2

Material: Steel.

Article: Bearings, motor parts and other aircraft engine parts, some with counter-sunk holes.

Method of Forming: Forging.

Final Finish: Smooth with burrs removed and slight radius provided.

Lea Method:

Lea Compound Grades "L," "B" or "C" at 5500 surface feet per minute on various types of buffs, string brushes, leather bobs, etc., depending upon the shape of the piece and the accessibility of the surface to be abraded.

Remarks: Work of this type had previously been done by hand with files, emery cloth or burring tools. Lea Compound removes all metal marks and burrs much faster and more economically than hand work. Tolerances are protected by the flexibility of the Lea Compound wheel.

CASE STUDY #3

Material: Brass and bronze.

Article: Bookends and novelties.

Method of Forming: Casting.

Final Finish: Brushed effect.

Lea Method:

1. Lea Compound Grade "C" on 8" loose wheel at 1500 to 2000 r.p.m.
2. Lacquering.

Remarks: Lea Compound is especially applicable to this type of work as there are numerous recesses in which buffing dirt would lodge with the older method using Tripoli buffing and wet scratch brushing. Accordingly, costly hand cleaning is thereby eliminated.

CASE STUDY #4

Material: Brass.

Article: Door knobs and escutcheon plates.

Method of Forming: Stamping.

Final Finish: Oxidized and relieved.

Lea Method:

1. Cut-down buffing with Tripoli of surface previously polished.
2. Clean.
3. Oxidized in liquid sulphur.
4. Lea Compound Grade "FG" on a 12" diameter loose muslin buff at 1200 r.p.m.
5. Lacquering.

Remarks: Grade "FG" Lea Compound gives a medium butler relieving which requires no cleaning or drying before lacquering.

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